A star (✱) indicates hat the Abstract deals with Apparatus and Instruments.

MAY, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

1857. Stability of Nuclei against β-Emission. K. Fuchs. *Cambridge Phil. Soc., Proc.* 35. *pp.* 242–255, *April*, 1939.—By means of purely qualitative arguments which do not depend on any particular model, the general scheme of stable nuclei and the isotopic breadth of nuclei with odd charge number are explained. The breadth of the isobaric region can be obtained if the numerical values of certain energies are known. Though these can be estimated only very roughly, the values for the breadth of the isobaric region obtained in this way are in good agreement with the experimental values. The increase in the breadth of the isobaric region from light nuclei to heavier nuclei can be explained, but no plausible explanation has been found for the fact that the breadth decreases again for the heaviest nuclei. AUTHOR.

1858. Variations in Relative Abundance of Carbon Isotopes. A. O. Nier and E. A. Gulbransen. *Am. Chem. Soc., J.* 61. *pp.* 697–698, *March*, 1939.—A mass-spectrometer of high sensitivity and high resolving power has been applied to determine the variations in the relative abundances of the C isotopes in naturally occurring forms. The compounds studied fall naturally into four groups: (1) igneous C, (2) limestones, (3) plant forms, and (4) unclassified. The $C^{12}/^{13}$ ratio appears to depend upon the classification of the compound. In general, the heavy isotope seems to be preferred in limestones and the light isotope in plant forms. The maximum variations in the C^{12}/C^{13} ratio are about 5 %. The atomic weight of C is calculated to be 12·012 based on a value of 90 ± 2 for the ratio in air. AUTHORS.

1859. Isotopic Constitution of Ni and Cr. W. A. Lub. *K. Akad. Amsterdam, Proc.* 42. 3. *pp.* 253–256, 1939.—The isotopic constitution of Ni and Cr is studied. In agreement with the results of the experiments of Aston and Dempster, the existence of ^{61}Ni is proved. This isotope is found, however, with a much smaller abundance than indicated by Dempster. The ratio of the intensities of ^{61}Ni : ^{64}Ni, is found to be 1 : 10. For Ni of mass numbers 58, 60, 61, 62 and 64, the respective % abundances are 68·0, 27·2, 0·1, 3·8 and 0·9. For Cr the existence of the new isotope ^{56}Cr is indicated as very probable. AUTHOR.

1860. Masses of Li^6, Li^7, Be^8, Be^9, B^{10}, and B^{11}. S. K. Allison. *Phys. Rev.* 55. *pp.* 624–627, *April* 1, 1939.—The energy values of the two modes of disintegration of Be under proton bombardment, determined by electrostatic analysis, are used in connection with other selected energy release values to set up masses for some of the lightest atoms. It is shown that introduction of the revised electronic charge makes negligible changes (less than 0·07 %) in the accepted range-energy curve for α-particles. It is assumed that the masses of H, D and He^4 are 1·00813 ± 0·00002, 2·01473 ± 0·00002 and 4·00386 ± 0·00006. The deduced masses are:

$Li^6 = 6{\cdot}01670 \pm 0{\cdot}00012$ $Be^8 = 8{\cdot}00753 \pm 0{\cdot}00013$ $B^{10} = 10{\cdot}01579 \pm 0{\cdot}00022$
$Li^7 = 7{\cdot}01799 \pm 0{\cdot}00011$ $Be^9 = 9{\cdot}01474 \pm 0{\cdot}00014$ $B^{11} = 11{\cdot}01244 \pm 0{\cdot}00019$.

These masses are compared with several observed nuclear reactions and mass-spectrographic doublets. AUTHOR.

1861. Application of X-Ray Fourier Analysis to Questions of Chemical Linking. R. Brill, H. G. Grimm, C. Hermann and C. Peters. *Ann. d. Physik*, 34. 5. *pp.* 393–445, *March*, 1939.—Consideration of results with substances known to contain various types of linking shows that it is possible to discover by means of Fourier analysis, characteristic differences in the electron distribution in compounds with heteropolar and homopolar linkages. The electron density falls almost to zero between the ions in the heteropolar linking, whilst in the case of the homopolar linking, the electron density projected on to the line joining the atoms usually differs considerably from zero owing to the presence of exchange electrons which effect the linking. For hexamethylene-tetramine an electron density corresponding to a van der Waals linking was not found. There are rather localised electron bridges from molecule to molecule, which can be regarded as a weak chemical combination (residual valency). This is in agreement with the chemical properties of the substance.

A. J. M.

1862. Structure of Trimethylamine Oxide and Dimethyl Sulphone and Lengths of Coordinate Links. M. W. Lister and L. E. Sutton. *Faraday Soc., Trans.* 35. *pp.* 495–505, *April*, 1939.—The structures of trimethylamine oxide and dimethyl sulphone have been investigated by the electron diffraction method. In trimethylamine oxide, the C–N length was found to be 1·54 ± 0·03 Å, which is 0·07 Å greater than the sum of the normal single covalent radii, while the N–O length was found to be exactly equal to the sum of the normal single-bond radii, 1·36 ± 0·03 Å. N appears, therefore, to have a greater radius when four-covalent than when three-covalent, and on this radius the coordinate NO bond is shortened, possibly because of the effective charges at its two ends. In dimethyl sulphone the increase of valency of the S was also found to cause an increase in radius, for the C–S bonds, 1·90 ± 0·03 Å long, are 0·09 Å longer than those in dimethyl sulphide, but the SO bonds were found to be very short, only 1·44 ± 0·03 Å. On the divalent radius for S, they are shorter than double bonds, and on the new larger radius for S in this molecule they are as short as triple bonds. Nevertheless, it is considered that they are most probably double bonds and that the extra contraction may be connected with their stability. AUTHORS.

1863. Formation of Helium Molecules. Part II. F. L. Arnot and M. B. M'Ewen. *Roy. Soc., Proc.* 171*A*. *pp.* 106–120, *May* 1, 1939. —An investigation of the formation of ionised helium molecules has been made by means of a mass-spectrograph. The results obtained confirm the conclusion reached in Part I [see Abstract 2656 (1938)] on this subject from less definite evidence. It is shown that helium molecular ions are formed by the attachment of atoms in the 1*s* 2*s*, ^3S metastable state of 19·77 eV energy to normal atoms in the ground state $1s^2$, $^1S_0$ according to the process

$$\mathrm{He}(1s^2,\ ^1S_0)+\mathrm{He}'(1s\ 2s,\ ^3S)\rightarrow \mathrm{He}_2^+(1s\sigma^2\ 2p\sigma,\ ^2\Sigma_u^+)+\epsilon.$$

Since the ground state of the neutral molecule is unstable this process fixes an upper limit of 19·77 V for the ionisation potential of the molecule. The lower limits for the work of dissociation of the neutral molecule in its lowest stable state $1s\sigma^2\ 2p\sigma\ 2s\sigma$, $^3\Sigma_u^+$ and of the ionised molecule are found to be respectively 4·23 and 4·70 eV, which are both 1·7 eV higher than the usually accepted values. Attention is drawn to the fact that these molecular ions are formed from excited atoms in S-states, whereas the authors have shown that mercury molecular ions are apparently formed only by excited atoms in P-states. AUTHORS.

See also Abstracts 1888, 1896, 2021, 2030, 2219.

COLLOIDS.

1864. Problems of Stability in Hydrophobic Colloidal Solutions. Parts I and II. S. Levine. *Roy. Soc., Proc.* 170*A. pp.* 145–182, *March* 21, 1939.—In Part I a method of obtaining the mutual electrical energy of two colloidal hydrophobic spherical particles has been developed by application of the Debye-Hückel theory of electrolytes. It is found that the electrical forces are repulsive at small separations, but become attractive at large, passing through a zero where the energy is a minimum. There are two distinct terms in the energy function representing (1) the repulsion experienced by a particle when it enters the field of another, and this term is the more important at small separation ; (2) the attraction exerted upon the ionic atmospheres when overlapping occurs, this being the dominating contribution at large distances. The van der Waals attractive energy has been computed for a particular case, and is a maximum at a short distance from contact. The value of this energy is the controlling factor in coagulation, and its amount diminishes with electrolyte concentration. The theory suggests an explanation of the fact that with electrolytes which coagulate at low concentrations, the critical potential is much lower than with electrolytes which precipitate at large concentrations. The Schultz-Hardy rule is discussed, since the approximate Debye-Hückel equation cannot give an explanation for the ions of higher valency. The energy minimum is characteristic of all hydrophobic sols containing spherical particles and is always negative at large distances. It is likely that, at least for hydrophobic sols, thixotropy and related phenomena are associated with this minimum in the electrical energy and not with the van der Waals energy. The method of calculating the osmotic pressure from the expression for the interaction energy is indicated. In Part II, the mathematical method of deriving the mutual energy of two colloidal metallic particles is developed to second and third approximations. An *Appendix* includes a statistical analysis of the free-energy data now evaluated. It is found that the Debye-Hückel theory of electrolytes can be applied more satisfactorily to colloidal solutions than to ordinary electrolytic ones, even if the electrolyte present in the sol is of an unsymmetrical type. H. H. Ho.

1865. Double Refraction of Flow of Colloids and Large Molecules in Solution. A. Peterlin and H. A. Stuart. *Zeits. f. Physik,* 112. 1–2. *pp.* 1–19, 1939.—After a critical survey of other theories the strict continuum theory of the double refraction of flow for solid rotation ellipsoids in suspension is developed. Its application to the determination of the size and form as well as the optical constants of the particles is discussed. The assumptions under which the theory may be used for the investigation of colloids and macro-molecules in solution are defined. [See Abstract 1446 (1939) and following Abstract.] J. J. S.

1866. Determination of Size and Form and of Electrical, Optical and Magnetic Anisotropy of Sub-Microscopic Particles by Double Refraction and Viscosity. A. Peterlin and H. A. Stuart. *Zeits. f. Physik,* 112. 3–4. *pp.* 129–147, 1939.—The equations are homogeneously derived for the electrical, magnetic and flow double refraction by means of the continuum theory of solutions when viscosity is also taken into account. A complete method is available for the quantitative determination of size, form and anisotropy (form- and specific-anisotropy) of rigid non-conducting ellipsoids of rotation, which form may be assumed for colloids and large molecules in solutions. It is shown how form- and specific-double refraction may be distinguished. The methods given are available for particles of 10 to 50,000 Å dimensions. The particular method to be employed in practice depends on dimensions (average radius smaller or greater than 1000 Å) and further on whether form-anisotropy must be supplemented by specific-anisotropy. Finally the influence of swelling and solvation is discussed, and also the possibility explored as to whether, for larger particles, swelling may be determined from the course of the double refraction. [See preceding Abstract.] H. H. Ho.

1867. Mechanism of Cell Division. N. Rashevsky. *Math. Biophysics, Bull.* 1. *pp.* 23–30, *March*, 1939.—The recently developed approximation method for treating problems of cell biophysics is generalised and corrected in some points. The equations of elongation of a dividing cell of any shape are given for the most general case of finite permeability as well as of finite internal and external diffusion coefficients. [See following Abstract.] AUTHOR.

1868. Mechanics of Viscous Bodies and Elongation in Ellipsoidal Cells. G. Young. *Math. Biophysics, Bull.* 1. *pp.* 31–46, *March*, 1939.—After deriving some auxiliary equations for the average elongation of a viscous body under the action of forces derived from a potential, the diffusion problem for an ellipsoidal cell with a constant rate of reaction is solved for the case of an infinite permeability. The equation of elongation of such a cell under the influence of diffusion forces is derived, and compared wtih the approximate expression obtained by N. Rashevsky [see preceding Abstract] for any kind of oblong cell. The two equations are in fair agreement. Effects of constant and variable surface tension are studied. AUTHOR.

***1869. Apparent Fluidity of Dispersions of Cellulose in Cuprammonium Solution. R. T. Mease.** *Bureau of Standards, J. of Research,* 22. *pp.* 271–284, *March*, 1939.—The importance of the cuprammonium fluidity test for the indication of fundamental change in cellulose, particularly in the earlier stages of degradation, is quite generally recognised. Without special equipment and technique, however, the test is difficult to perform. It is the object of this paper to describe relatively simple equipment and technique found practical for measurement of the apparent fluidity of dispersions of cellulose in cuprammonium solution. Directions are given for the preparation and storage of the cuprammonium solution; for the construction and calibration of viscometers; for the dispersion of cellulose in the cuprammonium solution; and for the measurement of the fluidity of the dispersion. Some of the difficulties which arise in precise measurements are indicated, and data illustrating the duplicability of results are presented. AUTHOR.

1870. Viscosity of As_2S_3 Sols and Einstein's Formula. A. Boutaric and S. Thévenet. *Comptes Rendus*, 208. *pp.* 746–748, *March* 6, 1939.—The value of k in Einstein's formula $k = (\eta - \eta_0)S/c\eta_0$, where η is the viscosity of a dilute suspension of rigid spherical granules, η_0 that of the medium in which they are suspended, c the concentration of the suspension in gm./unit of volume, and δ the specific mass of the material of the granules, was determined for sols of As_2S_3 of varying concentration and age [see Abstract 13 (1938)]. Increase in age and δ causes diminution in *k*, increase in dilution causes little change; diminution due to age is more rapid the higher the temperature at which the sol is maintained, tending in time to Einstein's value of *k* (2·5) as a liimt. C. A. S.

1871. Viscosity of Colloids. Part I. Anomalous Viscosity of Dilute Suspensions of Rigid Anisometric Particles. J. R. Robinson. *Roy. Soc., Proc.* 170*A*. *pp.* 519–550, *April* 21, 1939.—The nature of the anomalous viscosity of dilute suspensions of rigid, anisometric, colloidal particles has been elucidated by a combination of simultaneous measurements of the optical and viscous behaviour of the suspensions with an approximate theoretical treatment. It is found that with increasing rates of shear the particles become more and more oriented, the orientation being measured in direction by the angle of isocline, and in intensity by the double refraction of flow. Meanwhile, the overall viscosity falls towards that of the solvent. It is shown that the overall viscosity exceeds that of the solvent as a result of energy dissipated through the disturbance of the field of flow of the solvent by the precessional motion which it imposes upon the particles. As increasing rates of shear are applied, the precessional motions change in a manner which, statistically considered, constitutes the orientation of the particles. In the course of this orientation the extra dissipation of energy due to the particles becomes less in comparison with that involved in the flow of the solvent alone. This is the physical basis of the anomalous viscous behaviour of the systems studied. AUTHOR.

1872. Coexistence of Reversible and Irreversible Aggregates in Thixotropic Gels Containing Hydrophobic Particles. W. Heller and É. Vassy. *Comptes Rendus*, 208. *pp*. 812–814, *March* 13, 1939.—Formation of reversible aggregates (geloids) as a preliminary to thixotropic solidification has already been proved [see Abstract 16 (1938)]. That irreversible aggregates may also be formed in such sols has now been demonstrated by following spectrographically the changes in absorption in a sol of Fe_2O_3 (1·64% Fe_2O_3) to which NaCl has recently been added, and which showed thixotropy at low, coagulation at high concentration; such formation is favoured by rise in temperature. C. A. S.

1873. Physics of Rubber. Part I. E. Guth. *J. of Applied Physics*, 10. *pp*. 161–171, *March*, 1939.—This first part of a review of the properties of rubber deals with the stress-strain relations, Poisson's ratio and the thermoelasticity of rubber. The stress-strain relations of rubber are compared with those of elastically normal materials. The S-shaped stress-strain curve of rubber indicates that at least three mechanisms act to cause the retraction. The heat developed in adiabatic stress may be divided into a small Joule effect and a heat of crystallisation. The very large cubical expansion of rubber is normal in that its value is the same under constant stress or strain, hence stretched rubber must possess a negative thermal expansion coefficient in the direction of the stress and a positive in a perpendicular direction. J. B. W.

1874. Two Forms of Protein Surface Films. M. Joly. *Comptes Rendus*, 208. *pp*. 975–976, *March* 27, 1939.—The surface viscosity, μ, of a protein film varies according as care is taken at the time of spreading that its pressure does not exceed a few tenths of a dyne, or not. In the former case μ remains small, of the order of 10^{-3}, and the film is stable. In the latter μ is much greater, thus for beef serum albumen on 0·01*N* HCl, with pressure of 4 dynes, μ may be 0·3. Further in this case the film ages, μ increasing with time and only becoming constant after several hours. It also increases with temperature; and above a certain pressure the film acquires a rubber-like consistence with a higher superficial density. [See Abstract 4824 (1938).] C. A. S.

1875. "Surface Elasticity" of Protein Films. Part I. Egg Albumin. J. B. Bateman and L. A. Chambers. *J. Chem. Phys.* 7. *pp.* 244–250, *April,* 1939.—The limiting area is the quantity by which protein films are usually described. This may give some indication of the "spreading tendency" of the protein, but it is not necessarily related to other mechanical properties of the film, since an unknown proportion of the protein may remain unspread, or may pass into solution in the substrate. This is demonstrated by an experimental study of the limiting areas and the surface elasticities, $M_s = -A\cdot dF/dA$, of egg albumin films as a function of pH. It is shown that the $M_s - F$ curves for this protein are of characteristic form, with a single well-defined maximum, $(M_s)_{max}$. It is shown further that the characteristic large variations of limiting area with pH are not reflected in the variation of $(M_s)_{max}$ and it is concluded that throughout the range of H-ion concentrations studied the observed elasticities are due to a monomolecular film of true limiting area $\sim 1\cdot 0$ m^2./mg. The lower values of the apparent limiting area obtained at certain H-ion concentrations are due principally to unspread material which does not contribute significantly to the mechanical properties of the film. It is suggested that the $M_s - F$ curves should be employed in place of the apparent limiting areas in the description of protein films and that the values of $(M_s)_{max}$ may provide a convenient means of showing specific differences between films of different proteins. AUTHORS.

1876. Streaming Potentials and Surface Conductivity. A. J. Rutgers and E. Verlende. *K. Akad. Amsterdam, Proc.* 42. 1. *pp.* 71–78, 1939.—The theory of the electrostatic potential distribution in a liquid is developed. The assumption is made that the charge of the diffuse layer remains constant through the whole range of the concentrations. In this way it is possible to calculate ζ as a function of the concentration. The comparison of the calculated values with those obtained by experiment show a satisfactory agreement. The surface conductivity requires the value of at least 50,000 to 150,000 e.s.u./cm^2. instead of 1740 e.s.u./cm^2. to account for the experimentally determined values. F. J. B.

1877. Conductivity of Gelatin in Acid Solution. W. K. Lewis and G. Broughton. *J. Phys. Chem.* 43. *pp.* 359–362, *March,* 1939.—The H-ion activity and conductivity of 1% gelatin solutions containing various amounts of HCl ($0 - 125 \times 10^{-4}\,N$) have been measured using a saturated calomel half-cell and a Wheatstone bridge with calibrated resistances and valve amplifier respectively. The ionic conductance of the gelatin chloride increases with the addition of HCl to a maximum at $67 - 76 \times 10^{-4}\,N$ and then falls away. This may be accounted for by the incomplete ionisation of the gelatin chloride or increased frictional resistance of the gelatin particle. F. J. L.

1878. Electrical Conductance of Sols and Gels and the Problem of Gel Structure. Part I. Gelatin. R. Taft and L. E. Malm. *J. Phys. Chem.* 43. *pp.* 499–512, *April,* 1939.—The electrical conductance of ash-free gelatin in both the sol state and the gel state has been determined at 25° C. and at 30° C. Conductance measurements were also carried out during the sol-gel transformation at constant temperature. In the cases studied, no abrupt change in conductance is observable when gelation takes place. There is, however, a gradual decrease in conductance during gelation, the maximum decreases in conductance lying between 4 and 8%. The electrical conductance of KCl and KCNS over a considerable range of concentrations, when present in gelatin sol and gel, has been determined at several constant temperatures. The conductance of the electrolyte is appreciably lower in the presence of gelatin, but is approximately the same in the sol and gel state, save at very dilute concentrations of electrolyte. KCNS shows a relatively greater decrease in conductance in the presence of gelatin than does KCl. The results are interpreted as evidence for (*a*) the fibrillar structure of gelatin gels and (*b*) the greater adsorption of thiocyanate ion than of chloride ion by gelatin. AUTHORS.

1879. Particle-Concentration and Aggregation of Aerosols. K. E. Stumpf. *Kolloid Zeits.* 86. *pp.* 339–361, *March*, 1939.—The errors in previous measurements of the particle-concentration of aerosols by means of the slit-ultramicroscope were found to be due to inaccurate determination of the volume in which the particles were counted. After standardisation of this volume, no systematic errors were found, and the average mass of a particle in an oleic acid smoke, calculated from the number concentration measured by means of the slit-ultramicroscope, and the mass concentration, was found to differ by only 18% from that calculated from the rate of settlement of the particles. The results of measurements of the concentration of particles at various times during the aggregation of iron oxide smokes supported Smoluchowski's coagulation theory. W. H. WAL.

See also Abstracts 1910, 1942, 2059, 2117.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

1880. Vector Maps of Finite and Periodic Point Sets. D. M. Wrinch. *Phil. Mag.* 27. *pp.* 490–507, *April*, 1939.—Vector maps of finite sets of points considered in a previous paper [see Abstract 508 (1939)], are now investigated analytically with particular reference to the structure of the hexadic vector maps belonging to triadic sets. The transition between vector maps of finite and periodic point sets, and the correlation between periodic point sets and their periodic vector maps are discussed in considerable detail. J. S. G. T.

1881. Electronic States at Surfaces of Crystals. Parts I-III. E. T. Goodwin. *Cambridge Phil. Soc., Proc.* 35. *pp.* 205–241, *April*, 1939.—In Part I it is shown that in a crystal there exist states in which the electron is bound to a surface of the crystal and has an energy lying within a forbidden band. The wave functions and energies of these states are calculated, on the nearly free electron approximation, in terms of the constants of the crystalline potential field, which is represented by a triple Fourier series having the periodicity of the lattice. The method is shown to be applicable to a general crystal having a surface parallel to any one of the crystal planes. In Part II the wave functions and energies of both the normal and surface electronic states of a finite linear chain are determined in terms of the overlap integrals by the approximation of tight binding, it being assumed that the interaction of atomic *s*-states with *p*-states can be neglected. It is shown that the existence of surface states depends on the ratio of two overlap integrals being greater than unity, and reasons are given for expecting this to be so. In Part III the method of Part II is extended to determine the surface states of a simple cubic crystal on the approximation of tight binding. It is also applied to the case of a semi-infinite linear chain when the atomic *s*- and *p*-states are to be regarded as degenerate, the existence of surface states being again predicted. AUTHOR.

1882. Number of Configurations in an Assembly and Co-operative Phenomena. T. S. Chang. *Cambridge Phil. Soc., Proc.* 35. *pp.* 265–292, *April,* 1939.—An ideal problem is considered of adsorption of single and double particles upon a solid surface which has its sites of accommodation regularly arranged, and by comparing the equilibrium properties obtained by Bethe's method with the ordinary statistical formulæ, approximate expressions are obtained for: (1) $g(N, n, X)$, the number of ways of arranging n particles upon N sites of a lattice so that the number of neighbouring sites occupied by the particles is X; (2) $g_2(N, n, X)$, the number of ways of arranging n double particles upon N sites so that each of the double particles takes up two adjacent sites and the number of neighbouring sites occupied by two different particles is X. Both these expressions are found to agree with the exact values when the N sites lie on a straight line. When the first expression is used to construct the configurational partition functions of certain physical assemblies and expand them in powers of $1/kT$, they are found to agree with the corresponding rigorous expressions as far as $(1/kT)^3$, which is the highest power which can be found rigorously at present. With the help of the first expression, formal equations for superlattice formation in an alloy with the composition 1 : 1 and equations for the separation into phases of regular liquids are given. Lastly it is shown that atoms and molecules in a regular liquid may dissociate or recombine suddenly accompanied by a latent heat. This is a new cöoperative phenomenon, which may bear some resemblance to the melting process between the solid and liquid states. [See Abstracts 908 and 1516 (1939).] AUTHOR.

1883. X-Ray Analysis of Ni-Si Alloys. A. Ôsawa and M. Okamoto. *Tohoku Univ., Sci. Reports,* 27. *pp.* 326–347, *Jan.,* 1939. *Report No.* 451 *of the Research Inst. for Iron, Steel and other Metals. In English.*—X-ray analyses have been carried out for Ni-Si alloys throughout the whole system. The results obtained are summarised in a table and some powder photographs of the phases existing in this system are shown. AUTHORS.

1884. Structure of Ferrocyanides. R. Rigamonti. *Gazz. Chim. Ital.* 68. *pp.* 803–809, *Dec.,* 1938.—The author reviews the available data. Ferrocyanides of Fe, Co, Ni, alone or as double salts with the alkali metals, crystallise in the same cubic system as that of $CuFe(CN)_6$. For ferrocyanides of Fe(ous), Co(ous), Ni and Cu (ic) $a = 10{\cdot}2, 10{\cdot}1, 9{\cdot}98, 10{\cdot}0$ Å respectively. Those of Zn and Cd, whether simple, or double alkali salts, crystallise with lower symmetry and are not isomorphous with the preceding ferrocyanides ; only in the case of a very thin film by examination with E-rays, was there evident a cubic structure of interstitial type, equivalent to that of $K_2CuFe(CN)_6$. For $K_2ZnFe(CN)_6$ $a = 9{\cdot}98$, for $K_2CdFe(CN)_6$ $a = 10{\cdot}03$ Å. The following double ferrocyanides of a trivalent and an alkali metal show the cubic structure of the divalent ferrocyanides, for $FeKFe(CN)_6$ $a = 10{\cdot}2$, for $AlKFe(CN)_6$ $a = 9{\cdot}78$ Å. The ferrocyanides of the following groups appear to show lower symmetry—Ca_2, Ba_2, CaK_2, BaK_2, Pb_2, CuCa, CuBa, CuSr, and CuMg. D. R. H.

1885. Dehydration of $Li_2O_2\cdot H_2O\cdot 3H_2O$ and Structure of Li_2O_2. A. Aguzzi. *Gazz. Chim. Ital.* 68. *pp.* 816–819, *Dec.,* 1938.—On dehydration of the compound *in vacuo* over P_2O_5, it was observed that the process took place much more rapidly at higher temperatures and that H_2O was evolved more readily than H_2O_2. In this way after 12 hr. a substance of composition [$Li_2O_2 \cdot 0{\cdot}066\ H_2O_2 \cdot 0{\cdot}009\ H_2O$] was secured. On examination by the powder method with Fe target, a clear negative is obtained but the bands are very diffuse owing to the small grain size resulting from the method of preparation. The results conform to $a/c = 0{\cdot}708$ in the tetragonal system, with the unit cell of side 5·47 Å, but some interference between α- and β-radiation makes the result equivocal. Density on putting $Z = 8$ is, however, in good agreement with that determined experimentally. D. R. H.

1886. Structure of Azides. M. Bassière. *Comptes Rendus,* 208. *pp.* 659–661, *Feb.* 27, 1939.—The lattice parameters of rhombohedral crystals of NaN_3 are redetermined as follows, $a = 5{\cdot}488 \pm 0{\cdot}011$ Å, $\alpha = 38° 43'$. The structure of the N_3 anion has been investigated by a one-dimensional Fourier analysis along the direction [111]. Good agreement is obtained between calculated and observed values of structure factors for the {111} planes. The interatomic distances agree with those of Knaggs [1935] for cyanuric triazide. A calculation is made of the Debye temperature and the value 505° K is close to the value 460° K obtained from two measurements of the specific heat. J. I.

1887. Unit Cell and Probable Space Group of $Sr(OH)_2,8H_2O$. D. P. Mellor. *Zeits. f. Krist.* 100. 5. *pp.* 441–442, 1939.—Re-examination of the structure of $Sr(OH)_2.8H_2O$ shows it to have $a = 8{\cdot}97$ Å, $c = 11{\cdot}55$, and 4 mols. in its unit cell; the space group is probably $D^2_{4h}(P4/m\,cc)$.
C. A. S.

1888. The Protein Molecule. *Roy. Soc., Proc.* 127*B*. *pp.* 1–40, *March* 10, *and* 170*A*. *pp.* 40–79, *March* 16, 1939.—A report of a Discussion.

T. Svedberg (*pp.* 40–56) in an introduction reviews the methods which can be used to study protein molecules and summarises the present state of knowledge of their properties. A good Bibliography is given.

K. Linderstrøm-Lang (*pp.* 56–57) discusses globular proteins and proteolytic enzymes.

G. S. Adair (*pp.* 57–58) discusses hydration in relation to size of molecules and the correlation of mobilities of protein ions with their electric changes.

K. O. Pederson (*p.* 59) puts forward a hypothesis for protein molecules which exhibit interaction phenomena.

F. J. Philpot and J. St. L. Philpot (*pp.* 60–61) give data on the effect of Ca on the sedimentation constant of casein.

J. St. L. Philpot and P. A. Small (*p.* 62) mention some experiments in which they measure the activity of pepsin for differing amounts of tyrosine substitution.

D. M. Wrinch (*pp.* 63–64) gives a brief summary of the cyclol hypothesis of protein structure.

A. Neuberger (*pp.* 64–65) puts forward some chemical data which are in conflict with the cyclol and frequency hypothesis.

S. J. Przyłecki (*pp.* 65–66) discusses some protein symplexes.

H. H. Weber (*pp.* 66–68) summarises data on muscle proteins and properties of muscle.

K. H. Meyer (*pp.* 68–69) puts forward a suggestion that some forms of protein denaturation may have as their basis the removal of supersaturation.

W. T. Astbury (*pp.* 69–70) gives some X-ray data on the structure of fibrous proteins.

G. Boehm (*pp.* 71–72) shows that the X-ray diagram of muscle is due to the myosin.

E. Gorter (*pp.* 72–73) discusses the method of monomolecular films as applied to protein investigations.

J. F. Danielli (*pp.* 73–74)1 shows that surface chemistry can given information on the intramolecuar forces of proteins.

D. Crowfoot (*pp.* 74–75) discusses the X-ray investigation of globular proteins.

J. D. Bernal (*pp.* 75–78) summarises the interpretation of the X-ray data on protein structure.

J. Marrack (*pp.* 78–79) discusses some immunological problems.

E. Holliday (*p.* 79) gives some results of an investigation of the breakdown products of an antigen. J. I.

1889. Structure of Globular Proteins. D. Wrinch. *Nature,* 143. *pp.* 482–483, *March* 18, 1939.—This paper is mainly a reply to criticisms by Bernal and Neuberger (*ibid.* 143. *p.* 74, *Jan.* 20, *and p.* 473, *March* 18, 1939) of the cyclol theory of protein structure. The author points out that the cyclol theory explains the existence of very large but chemically and physically well-defined molecules. Questions of detail can only be solved when more accurate physical and chemical data are available. J. I.

1890. Structure of Long-Chain Normal Paraffin Hydrocarbons. "Shape" of CH_2 Group. C. W. Bunn. *Faraday Soc., Trans.* 35. *pp.* 482–491, *April,* 1939.—Crystals of very long chain normal paraffin hydrocarbons with chains of more than 130 C atoms are orthorhombic, with $a_0 = 7 \cdot 40$, $b_0 = 4 \cdot 93$, $c_0 = 2 \cdot 534$ Å. The space group is P*nam*, the four C atoms in the cell being at $x, -y, \frac{1}{4}$; $-x, y, \frac{3}{4}$; $-x + \frac{1}{2}, -y + \frac{1}{2}, \frac{3}{4}$; $x + \frac{1}{2}, y + \frac{1}{2}, \frac{1}{4}$, where $x = 0 \cdot 038\, a_0$ and $y = 0 \cdot 065\, b_0$. This gives the aliphatic C − C distance = 1·53 Å, and the zigzag angle 112°. Electron-density diagrams have been obtained by three-dimensional Fourier syntheses of the X-ray data. They show that the apparent shape of a CH_2 group is far from spherical, the electron cloud being much drawn out in the plane of the three nuclei. This fact was evidenced in the earlier stages of the structure determination by large systematic discrepancies among the intensities of the X-ray diffractions. Part of the magnitude of these discrepancies (but probably not more than half) may reasonably be attributed to anisotropic thermal motions of the atoms in the crystal; the rest appears to be due to a real distortion of the electron clouds of the CH_2 groups. AUTHOR.

1891. Light Scattering in Anisotropic Liquids. L. S. Ornstein and W. de Braaf. *K. Akad. Amsterdam, Proc.* 42. 2. *pp.* 105–106, 1939. *In English.*—Zwetkoff [see Abstract 49 (1939)] has shown that depolarisation for transmitted light diminishes strongly when the magnetic field is strengthened, and the present authors, who were wrongly credited with their work indicating an increase, now explain the phenomenon on the swarm hypothesis. Zwetkoff's result that no orientation of the particles in the swarms occur in strong fields and his assumption of orientation at the walls is agreed to. It is shown that while strong depolarisation in the nematic phase for strong fields is partly due to anisotropy, a part must also be ascribed to the effects of ray curvature in the swarms as a consequence of the systematic change of their refractive index. Only if the latter effect is taken into account, can an explanation be given of the difference in transmission for longitudinal and transverse illumination, and for the very strong scattering which occurs at an angle of 45°. The fact that the field does not influence the depolarisation is in accordance with the authors' explanation. H. H. Ho.

1892. Growth of Crystals. T. Yamamoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 878. *pp.* 228–289, *Feb.*, 1939. *In English.*—This paper deals with the influence of the kations of inorganic substances on the growth of crystals; most of the previous workers have studied the effect of organic substances and of inorganic anions. Observations on the growth of the chlorides of Na, K, Rb, Cs, Li and NH_4, of KBr, KI, K_2SO_4, KNO_3 and $KClO_4$ were made under the microscope. As a result of very many data it was concluded that the kations, if they were effective at all, caused the crystal to grow into a large and transparent one and also affected the development of crystal forms. This question of transparency is discussed in terms of velocity of growth and an attempt is made to relate the crystal size to the concentration of the effective kations in the solution. Analyses were carried out on the resulting crystals to determine the amount of the effective kation which crystallised in it. It was also observed that if an effective kation is present the solution is greatly supersaturated, and further that supersaturated state is very stable. G. G.

1893. Non-Cubic Growth of Single Crystals of Ag by Condensation from Vapour. J. H. Howey. *Phys. Rev.* 55. *pp.* 578–581, *March* 15, 1939.—The condensation of Ag vapour upon solidified, spherical drops of Ag has been found to produce straight, thin, single-crystal needles of Ag under certain conditions. The formation of the drops and the subsequent growth of the needles was a continuous process accomplished by condensing the vapour in a vacuum upon an iron surface as that surface was cooling from above the melting point of Ag to an equilibrium temperature just below the melting point. The shape and crystalline orientation of the needles indicate that they are the result of a nucleus growing by condensation much more rapidly in a certain (110) direction than in other directions, including other (110) directions. AUTHOR.

1894. Formation of Crystallisation Nuclei. G. Kornfeld. *Ann. d. Physik*, 34. 5. *p.* 488, *March*, 1939.—Experiments published by the author in 1916 show that the results of a recent paper of C. Hammer [see Abstract 53 (1939)] on the influence of impurities on crystallisation hold only for solutions of high impurity. L. E. F.

1895. Solubility and Size of Crystals. E. Hofer. *Zeits. f. phys. Chem.* 183. *Abt.A.* 6. *pp.* 455–461, 1939.—Saturated aqueous solutions at 40° of 7 different inorganic salts having solubilities (L) covering a range of 100-fold, were crystallised under identical conditions by evaporating to half their bulk in (*a*) 6 hours (*b*) 30 hours, and the average mass (M) of the resulting crystals determined. To a first approximation $M = L^2$. Solutions of Ag halides in NH_3 caused to crystallise out under comparable conditions by addition of ethyl acetate (which slowly removed the NH_3 by saponification) follow the same approximate law. S. J. G.

See also Abstracts 1965, 2124, 2152, 2187, 2224, 2239, 2265.

DENSITY.

1896. Ramsay and Steele's Vapour-Density Measurements. T. Batuecas. *Zeits. f. phys. Chem.* 183. *Abt.A.* 6. *pp.* 438–454, 1939.—The whole of the experimental results of Ramsay and Steele for the molecular weights of seven organic substances [see Abstract 889 (1904)] have been re-evaluated, and not only the vapour density measurements at 129·6° C. The original calculations are considered to have been inexact, though the measurements themselves were mostly reasonably accurate. Ramsay and Steele's conclusion that the vapour density method did not yield precise values for the molecular weights no longer appears to have been fully justified. R. W. P.

1897. Density of Soda-Potash-Silica Glasses as a Function of the Composition. J. C. Young, F. W. Glaze, C. A. Faick and A. N. Finn. *Bureau of Standards, J. of Research,* 22. *pp.* 453–464, *April,* 1939.—Certain relations between the specific volume and composition of glasses of the soda-silica series have previously been reported. Additional glasses were made in the same series and also in the potash-silica and soda-potash-silica series. The glasses were analysed and their densities measured. Analysis of the new data suggests that the specific volume-composition relations change definitely at compositions approximating those of eutectics, instead of at those of simple molecular ratios, as previously reported. AUTHORS.

DIFFUSION AND OSMOSIS.

1898. Diffusion of Water Vapour through Various Building Materials. J. D. Babbitt. *Canad. J. of Research,* 17. *Sect.A. pp.* 15–32, *Feb.,* 1939.—A method of measuring the diffusion coefficient of water vapour through solids is outlined, and a table of the coefficients for various materials used in building construction is given. The method of employing these coefficients to calculate the vapour pressure gradient through a typical wall is shown, and this is applied to estimate the resistance to water vapour necessary to prevent condensation. AUTHOR.

1899. Diffusion of H_2 and D_2 through Fe. Part I. Fe as Kathode of a Glow Discharge. A. Güntherschulze, H. Betz and H. Kleinwächter. *Zeits. f. Physik,* 111. 9–10. *pp.* 657–679, 1939.—The H_2 ions which pass through a thick Fe plate which forms the kathode of a glow discharge follow the normal diffusion laws. It diffuses both as protons and atoms. The diffusion constant of the protons is 5 to 10 cm^2./day irrespective of temperature, and that of the atoms, 0·7 cm^2./day at 0° C. and is exponential with temperature. Above 2000 V the whole of the H_2 bombarding the plate passes through. The diffusion is markedly reduced by rubbing the inner surface of the iron with emery, but not the outer surface. A plate becomes temporarily impermeable if it is used as the kathode of an argon glow discharge, but regains its permeability in a H_2 discharge. H_2 and D_2 diffuse at equal rates. Proton diffusion does not occur in Al, Cu, Ag, Pt, Ni and Pd, and only Pd allows appreciable atomic diffusion at room-temperature. Small quantities of H_2 diffuse through an iron anode. P. H. B.

See also Abstracts 1867, 1868.

ELASTICITY AND PLASTICITY.

1900. Tables of Moments and Deflections for a Rectangular Plate. T. H. Evans. *J. of Applied Mechanics,* 6. *A*7–*A*10, *March,* 1939.—The problem of the clamped rectangular plate with a uniform load was solved by Hencky in 1913 and independently by Boobnoff in 1914. The former calculated values only for the case of a square plate. In 1937, Wojtaszak [see Abstract 446 (1938)] using Hencky's method, calculated several other cases. In this paper the maximum moments and deflections for all side ratios between 1·0 and 2·0, by intervals of 0·1, are determined following Hencky's procedure. Growing out of the necessity for solving 8 groups of simultaneous equations in 12 unknowns a short cut on the usual trial and error process of solution is developed. AUTHOR.

1901. Theory of Elasticity of the Second Order with Application to the Theory of "Flambage." M. Biot. *Ann. Soc. Sci. de Bruxelles,* 59. *pp.* 104–112, *March* 31, 1939.—A theory of elasticity taking into account terms of the second order in the expressions for rotations and tensions is developed. The results are applicable to a rigorous theory of the propagation of waves in a medium initially under tension and to the phenomenon of unstable elastic equilibrium generally termed "flambage." J. S. G. T.

1902. Problems of Finite Strain. Part I. B. R. Seth. *Phil. Mag.* 27. *pp.* 286–293, *March,* 1939.—Two problems are solved, those of a circular cylinder and a sphere under radial body force. The material is assumed incompressible, and the solutions are compared with those for the ordinary theory. [See Abstract 3452 (1936).] W. G. B.

1903. Direct Determination of Stresses from Stress Equations. Part II. B. Sen. *Phil. Mag.* 27. *pp.* 437–444, *April,* 1939.—In this continuation paper [see Abstract 3499 (1938)] two-dimensional thermal stresses are obtained directly from the stress equations of equilibrium and compatibility in certain problems of plane deformation. Thermal stresses are produced in a body by unequal distribution of temperature, which may be regarded as a specified function of coordinates and time; the distribution is determined by the laws of heat conduction and there are two classes of problem according as the temperature is steady or variable. It is found that $\odot(=\widehat{xx}+\widehat{yy})$ can be split up into two parts, one $\odot_{\mathrm{T}}$ depending on temperature and the other $\odot_{\mathrm{O}}$ independent of it. Stresses are deduced from these two parts of $\odot$ and the constants involved are so adjusted as to satisfy the required boundary conditions. In many problems stresses contributed by $\odot_{\mathrm{O}}$ are already well known. Hence in these cases only the stresses produced by $\odot_{\mathrm{T}}$ are to be found. When the temperature is variable $\odot_{\mathrm{T}}$ is given by $\odot_{\mathrm{T}} = -\mathrm{E}\alpha\mathrm{T}/(1-\sigma)$, where T is the temperature at (x, y) and α is the coefficient of linear expansion (assumed to be constant), and the values of the corresponding stress components are then easily computed. H. H. Ho.

1904. Non-Linear Theory of Elasticity and Linearised Case for a Body under Initial Stress. M. A. Biot. *Phil. Mag.* 27. *pp.* 468–489, *April,* 1939.—A non-linear theory of elasticity including terms of the first and second order is developed. A new definition of strain components, which are linearly related to the actual change of distance between two neighbouring points in the material under stress, is introduced. The stress condition is referred to a local system of axes rotating with the material, and equilibrium conditions for the stress components are investigated by two methods. The appropriate equations contain explicitly only those second-order terms which are of kinematic origin. A linear theory of elasticity for bodies under high initial stress, and a theory applicable to the case when the rotation is large relatively to the strain, are discussed. J. S. G. T.

1905. Stress Distribution in Aeolotropic Circular Disc. H. Ôkubo. *Phil. Mag.* 27. *pp.* 508–512, *April,* 1939.—In continuation of previous work [see Abstract 2932 (1937)] the author, using Wolf's result for the stress function in an aeolotropic body, derives an approximate solution for the stress components in an aeolotropic circular or elliptic disc subjected to two opposite forces along the axis of symmetry. Numerical results for a thin elliptic quartz plate cut in a plane containing the principal axis and normal to the plane of symmetry, and compressed by opposite and equal forces applied at the end of the minor axis are derived. J. S. G. T.

1906. Theory of Fatigue of Metals. E. Orowan. *Roy. Soc., Proc.* 171*A*. *pp.* 79–106, *May* 1, 1939.—The present theory of fatigue is based upon the fact that plastic deformation is not homogeneous. The stress acting upon a plastic inhomogeneity that is embedded in elastic surroundings is a function of its plastic strain, diminishing with increasing strain. This fact, with the assumption that the plastic spot is subject to strain hardening of the usual kind, leads to the existence of safe and unsafe ranges. The derived dependence of the safe range upon the mean stress of the cycle is the same as that deduced by McAdam from empirical data. The relation between the stress range and the number of cycles after which a crack is formed, as calculated from the theory, is in accord with the typical log S-log N curves given by experiments. Conclusions from the theory about fatigue endurance at elevated temperatures, about the correlation between fatigue endurance and strength, about mechanical hysteresis, etc., are confirmed by experience. AUTHOR.

1907. Elastic Deformation in Rochelle Salt. H. Hinz. *Zeits. f. Physik*, 111. 9–10. *pp.* 617–632, 1939.—Rochelle salt is now becoming of importance, in addition to quartz and tourmaline, as a piezoelectric crystal, and a knowledge of its elastic constants is required. Several investigations of these have been made, both by the dynamic and the static methods, and an unexplained difference of about 15% exists between the two sets of results. The nine elastic constants have now been measured by a simple method of applying surface pressures to rectangular prisms of crystal material of appropriate orientation. A modification, for which certain advantages are claimed, of the method for cutting a crystal by means of a " saw " composed of a moving wet thread is described. The changes of length brought about by the pressures are measured by an optical lever. The elastic constants thus determined agree with those previously determined by the dynamical methods. Deformation in an electric field was also studied in a preparation $\perp a$, 45° bc; it is markedly dependent on temperature. G. G.

***1908. Standardisation of Hardness Tests for Knife-Edges and Bearing Surfaces of Balances. H. Johannsen.** *Phys. Zeits.* 40. *pp.* 185–201, *March* 15, 1939. *From the Reichsanstalt.*—Until recently, official standardisation of the hardness of steel knife-edges and bearings used in commercial balances in Germany has been performed by means of a direct scratch test, using a standard file. The results obtained were found to be subject to a considerable range of personal interpretation, and a revised specification has now been introduced which requires a comparative scratch test to be made. It has been shown by investigation that small differences in hardness can be recognised by the file test if a standard is provided, and for this purpose special test specimens of the required hardness, certified by the P.T.R., are issued. The test pieces are examined for certification by means of a diamond cone indentation machine, which measures the depth of indentation under known static loads and gives direct values of hardness number in terms of the Rockwell Scale (American). A description of the machine is given together with the results of a complete investigation of possible sources of error. With a suitable technique it is shown that a reliability of ± 0·25 unit (Rockwell) can be obtained. H. B.

1909. Moisture Content and Flow-Point Pressure of Plastic Clay. R. T. Stull and P. V. Johnson. *Bureau of Standards, J. of Research*, 22. *pp.* 329–337, *March*, 1939.—A study was made to determine the relation between moisture content and "flow-point pressure" of a Maryland clay, a Georgia kaolin, and a Kentucky ball clay. Their moisture contents ranged from 17 to 34, 20 to 40, and 26 to 52% respectively, and the flow-point pressures ranged from 8 to 400 lb./in^2. The clays were extruded from a knife-edged die by means of a cylinder and a mechanically driven piston. The flow-point pressures were determined on the average of 18 load readings for each test, and the percentages of moisture determined on a composite sample of 18 portions of the clay column. Tests were also made with two extrusion cylinders of different sizes and three dies of different diameters in a study of the effect of different cylinder and die sizes upon the flow-point load. AUTHORS.

1910. Strength of Glass Fibres. F. O. Anderegg. *Indust. and Engin. Chem.* 31. *pp.* 290–298, *March*, 1939.—The strength of glass fibres is reduced by discontinuities but by thorough melting and suitable attenuation methods the trouble is greatly reduced. Strengths of the order of 400,000 lb./in^2. are produced commercially. The finer the fibre the greater the strength since the discontinuities are elongated lengthwise. In treating the results of strength tests the scatter in strength values is considerable, but the shorter the fibre tested the higher the average results. The rupture is probably affected also by thermal energies which vary from atom to atom. Glasses low in alkali or entirely free from it withstand acidic attack quite well, whilst fused silica gives strengths as high as 3,500,000 lb./in^2. A method of determination of strength of fibres is outlined making use of loading by means of a chain. The paper deals with such issues as fibre flexibility, elongation at break, etc., and points out that whilst organic fibres stretch up to 20% before rupture yet the glass fibre showed no evidence of plastic flow at all. The results of large and fine fibres are compared with rayon. S. G. B.

See also Abstracts 1873, 2003.

GRAVITATION.

1911. Absolute Determination of "g." J. S. Clark. *Roy. Soc., Phil. Trans.* 238*A*. *No.* 787. *pp.* 65–123, *Feb.* 17, 1939.—An absolute determination of *g* was carried out at the N.P.L., using a reversible pendulum swinging *in vacuo* on a fixed knife-edge. The two plane bearing surfaces were carried on the pendulum itself. The pendulum was designed to be as rigid as possible, and special attention was given to the calculation of the correction due to the elastic deformation of the pendulum when oscillating. Investigations were also made to determine the corrections due to the small finite radius of curvature of knife-edges, the elasticity of the support, the amplitude of oscillation, and the residual pressure. The mean result gave the value of *g* at the N.P.L. (latitude 51° 25′ 14″ N., longitude 0° 20′ 21″ W., and height above mean sea level 10 m.) $981 \cdot 181_5$ cm./sec^2., and reasons were given for believing that the true value of *g* at the N.P.L. does not differ from the above mean value by more than ± 1·5 milligal. J. S. C.

1912. Variations of Gravity at One Place. O. H. Truman. *Astrophys. J.* 89. *pp.* 445–462, *April*, 1939.—This paper deals with a four months' series of gravity observations made at Houston, Texas, with an instrument having a probable error for one reading of about 0·00002 cm./sec^2. There are slow apparent changes depending upon the weather, a diurnal and a semi-diurnal change depending upon the sun, and periods depending upon the tidal effect of the moon in distorting the earth or in shifting water on it. These are discussed at length. There is no proof of any variation arising from the earth's absolute motion through space, and none is to be expected unless from a much longer series of observations. AUTHOR.

***1913. Bar Pendulum. D. Owen.** *Phys. Soc., Proc.* 51. *pp.* 456–458, *May,* 1939.—The time of oscillation of a bar pendulum is shown to be practically unaffected by the use of a carriage supporting the knife-edge and sliding along the bar; the accuracy of the usual laboratory exercise on the bar pendulum is considerably increased. With a stop-watch showing tenths of a second the value of *g* can be determined quickly to within a few parts in 10,000. AUTHOR.

See also Abstracts **1913, 1938, 1939, 2235.**

HYDRODYNAMICS AND AERODYNAMICS.

1914. Variation of Force on a Solid Moving in Air. J. Villey and R. Jamin. *Comptes Rendus,* 208. *pp.* 628–630, *Feb.* 27, 1939.—Expressions for the resistance, F, of the air (pressure p, density d) to the translation of a body with velocity V, given by Sarrau, Darrieus, Langevin, are briefly discussed, and attention is directed, more especially, to Sarrau's result, obtained by dimensional analysis, *viz.*, $F = \kappa p \psi(V^2 d/p)$ or $\kappa p \phi(V^2/a^2)$ where $a = (\gamma p/d)^{1/2}$, the velocity of sound. The proportionality of F to V^2 in air under definite conditions is a satisfactory experimental approximation. It is pointed out that the law of proportionality between F and V^2 is the same as that for the pressure difference deducible by the application of Bernoulli's law to the isentropic entrainment of air by a moving body. This result for the global value of F is not, *a priori*, to be anticipated; the value of the pressure difference is derived in the form of a series of terms of even powers of α^2 where $\alpha = V/a$. J. S. G. T.

***1915. High Speed Wind Tunnels. B. V. Korvin-Kroukovsky.** *Frank. Inst., J.* 227. *pp.* 461–471, *April,* 1939.—The experiments on efflux of gases from orifices show that important changes occur in the properties of a gas accelerated to high velocity, apparently due to changes in the distribution of molecular energies. These changes indicate that conditions of the air flow around a body depend not only on the relative velocity, but on the absolute velocity of the air as well. Therefore, the results of the model tests obtained in wind tunnels at the velocity approaching that of sound do not correspond to the practical case of a body moving through still air. In particular, the occurrence of the compression shock appears to represent the characteristic of the high speed air stream, rather than that of the high relative velocity of the model and the air. AUTHOR.

1916. Motion of Fluid in Hydrodynamical Tunnels. G. Krall and W. Gröbner. *Ricerca Scientifica,* 10. *pp.* 42–48, *Jan.–Feb.,* 1939.—The paper gives an analysis of the flow through two new tunnel models, one with rectangular cross-section and the other having radial symmetry. W. A. R.

1917. Definition of Turbulence. G. Dedebant and P. Wehrlé. *Comptes Rendus,* 208. *pp.* 625–628, *Feb.* 27, 1939.—The character of turbulence is discussed in terms of contingent functions. J. S. G. T.

918. Spectrum of Homogeneous Turbulence. J. K. de Fériet. *Comptes Rendus,* 208. *pp.* 722–725, *March* 6, 1939.—Taylor in his discussion of the partititon of energy amongst the frequencies in turbulent motion has assumed that the spectrum of frequencies is a continuous one [see Abstract 953 (1938)]. Here the author considers mathematically a spectrum of frequencies comprising rays and bands. Taylor's results are comprised in the formula deduced for the displacement of the particles. J. S. G. T.

1919. Isotropy of Turbulent Motion and the Partition of Energy between Translations and Rotations. M. Luntz. *Comptes Rendus,* 208. *pp.* 725–727, *March* 6, 1939.—It is shown that, under certain conditions, Taylor's conception of the isotropy of turbulent motion conforms with the Maxwellian equipartition of energy amongst the various degrees of freedom. [See Abstract 4101 (1935).] J. S. G. T.

1920. Modes of Resolution of a Liquid Jet into Drops. G. Littaye. *Comptes Rendus,* 208. *pp.* 788–790, *March* 13, 1939.—The resolution of a liquid jet into drops may occur in one of three modes termed respectively, capillary resolution, transverse oscillation and pulverisation. Results obtained by Haenlein and by v. Ohnesorge are plotted so as to bring out in the diagram the separate regions characterised by the three types of resolution. The author has investigated whether capillary resolution may not occur in the region characterised by Haenlein and v. Ohnesorge as that of transverse oscillation. The results suggest that Haenlein's and v. Ohnesorge's results may represent an upper limit of the region of capillary resolution, and that irregularities of the orifice play a very important rôle in the generation of transverse oscillation of a jet. **Errata,** *ibid. p.* 1256, *April* 17, 1939. J. S. G. T.

***1921. Mensing-Werner Current-Meter. A. Werner.** *Zeits. f. Instrumentenk.* 59. *pp.* 82–88, *Feb.,* 1939.—In order to overcome the difficulties and inaccuracies of current-meters a new instrument has been designed. The current turns a propeller which is magnetically coupled to a revolving bar which operates a contact with an electric circuit. This relay lights a series of recording lamps which send rays on to a rotating sensitised film. The following records are simultaneously taken: the depth of the apparatus as recorded by a manometer; the time in hr., min. and sec.; and finally the current direction in the form of a compass-rose obtained by contact with a properly protected compass needle. The revolutions of the propeller in a given time-difference are the measure of current-velocity. W. A. R.

See also Abstract 1922.

KINETIC THEORY OF MATTER.

See Abstracts 2090, 2091, 2168.

MASS.

See Abstract 1908.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

1922. Potential Solutions near an Angular Point. B. R. Seth. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 136–138, *Feb.,* 1939.—Points out that the gradient of the potential at a salient angle is not infinite if the boundary and the physical conditions are symmetrical about the bisector of the angle. W. G. B.

1923. Geometrical Representation of Four, Five and Six Dimensions. C. Benedicks. *Comptes Rendus,* 208. *pp.* 778–780, *March* 13, 1939.—Three axes are chosen first which are 120° apart and may be represented by the diagonals of a cube and are thus defined solely by the selected rotation. To these are added axes involving translation in one or more directions. Diagrams are used to illustrate the conventions employed and the figures give a representation of 4, 5 or 6 dimensions. R. S. R.

1924. Covariation. É. Halphen. *Comptes Rendus,* 208. *pp.* 780–781, *March* 13, 1939.—The general method used to obtain the correlation of two phenomena each represented by a variable $x(t)$, $y(t)$ is stated. If only two curves are available this method cannot be used and differences from the mean have to be used. This statistical problem of covariation can be used to give results to the degree of accuracy required. The assumptions made and the method used are stated. R. S. R.

1925. Asymptotic Bisection of the Exponential Series and the Gamma Function for a Large Argument. R. Furch. *Zeits. f. Physik,* 112. 1–2. *pp.* 92–95, 1939.—The series $y(x) = (1 + x/\underline{|1} + \ldots + x^{n-1}/\underline{|n-1})/e^x$ for $x = n -$ const., and with very rapidly increasing approximation for $x = n - \frac{1}{3}$, assumes asymptotically the value $\frac{1}{2}$. This statement is valid also for the asymptotic bisection of the Γ-function $\Gamma(2) = \int_0^\infty e^{-t} \cdot t^{n-1}\, dt$, by displacement of the lower integration limit from 0 to ($n -$ const.), *i.e.* $(n - \frac{1}{3})$. This result has established an empirical emission theory discovered by Glocker [see Abstract 792 (1933)] which has an important rôle in biophysical investigations. The paper is entirely mathematical. H. H. Ho.

See also Abstracts 1880, 1966, 2174, 2175, 2190, 2225, 2235, 2255.

MECHANICS, CLASSICAL.

1926. Vector Theory of Non-Coplanar Forces. H. Bagchi. *Calcutta Math. Soc., Bull.* 30. *pp.* 105–146, *Sept.–Dec.,* 1938.—A paper in 5 sections investigating the theory of non-coplanar forces, acting on a rigid body, from the standpoint of vectorial geometry. These deal with diverse modes of reduction of a force-system, a certain related affine transformation, systems of rays and of forces in equilibrium, the theory of conjugate lines of a force-system, the linear complex of the set of nul lines, the connection between a linear line-complex and the complex of nul lines of a force-system, and finally, the quadratic complex which is formed by the axes of principal moment of an arbitrary system of forces. S. A. S.

See also Abstract 1881.

MECHANICS, QUANTUM.

1927. Existence of a Quantum of Length. J. Mariani. *Comptes Rendus,* 208. *pp.* 640–641, *Feb.* 27, *and pp.* 793–795, *March* 13, 1939.—It is suggested that space in the immediate neighbourhood of an elementary particle is not Euclidean, but is modified in such a way as to make the line element singular at a certain distance from the particle, so that smaller distances would have no significance. R. P.

1928. Self-Consistent Field for Doubly-Ionised Chromium. R. L. Mooney. *Phys. Rev.* 55. *pp.* 557–560, *March* 15, 1939.—A self-consistent field without exchange has been calculated for doubly-ionised Cr in the configuration $(3p)^6\ (3d)^4$. All integrations were carried out numerically with the aid of a calculating machine. The difference between the final and semi-final approximations to $Z_{n,l}$ is nowhere greater than $\pm 0 \cdot 003$. AUTHOR.

1929. Eigenfunctions in Wave Mechanics. W. Pauli. *Helv. Phys. Acta,* 12. 2. *pp.* 147–168, 1939. *In German.*—A proposal is made for a criterion to decide whether in a given wave equation single or twofold solutions are physically permissible. The criterion is that the single application of the angular momentum operator to a given system must not produce integrable solutions for the same value of the total momentum quantum number from the same system, *i.e.*, the new solutions so obtained should allow themselves to be expressed linearly in terms of the original solutions. Application to the scalar wave equation yields the necessity for single wave functions, while application to the Schrödinger form of the Dirac equation in polar coordinates shows the necessity of bivalent solutions. Both results are in agreement with practice. Further generalisations of the theory are indicated. G. O. B.

1930. Lorentz-Invariance in Quantum Theory. A. S. Eddington. *Cambridge Phil. Soc., Proc.* 35. *pp.* 186–194, *April,* 1939.—The formal conditions of Lorentz-invariance apply to coordinates x_1, x_2, x_3, ix_4 which form a 4-vector, and to expressions associated with them. In this paper attention is called to the frequent disregard in quantum investigations of the proviso that the coordinates form a 4-vector. In most quantum investigations with a practical application the coordinates employed are relative space coordinates ξ, η, ζ coupled with a progressive time coordinate, so that (ξ, η, ζ, it) is not a 4-vector. Nevertheless, conditions of Lorentz-invariance are applied by many authors. Alternatively, they attempt to base the investigation on wave functions of non-relative coordinates x, y, z, t. It is here pointed out that such wave functions give no information about the eigenstates, and that there is no means of deriving wave functions of ξ, η, ζ from those of x, y, z. Special attention is directed to the misapplication of Lorentz-invariance in Dirac's theory of the hydrogen atom, and in the calculation of degeneracy energy of ionised material. AUTHOR.

1931. Uncertainty of Reference Frame in Quantum Mechanics. H. C. Corben. *Cambridge Phil. Soc., Proc.* 35. *pp.* 195–204, *April,* 1939. —It is shown that, if account is taken of the uncertainty of position and momentum of the reference origin with respect to which observations are made, the self-energy and transverse self-energy of the electron become finite and the quantum theory is considerably modified for high-energy electrons and quanta. AUTHOR.

See also Abstracts 1932, 1939, 2187.

PHILOSOPHY OF SCIENTIFIC METHOD.

1932. Indiscernibility of Particles. P. Février. *Comptes Rendus,* 208. *pp.* 881–882, *March* 20, 1939.—Particles are said to be indiscernible from one another if there is no physically measurable character by which one could be distinguished from the other. Arguments are given in support of the proposition that indiscernibility in this sense implies indeterminism. The indeterminacy of position and momentum, for instance, is not a consequence of the idea of quantisation but of indiscernibility. G. C. McV.

PRESSURE.

***1933. Design of Accurate McLeod Gauge. P. Rosenberg.** *Rev. Sci. Instruments,* 10. *pp.* 131–134, *April,* 1939.—All McLeod gauges heretofore constructed with large volumes and fine capillaries have failed to attain the sensitivity, precision and accuracy which should be expected from the compression ratios. This is due to certain experimental difficulties which are enumerated. Description is given of a large McLeod gauge of which the methods of construction eliminate all these difficulties and the high sensitivity, precision, and accuracy are fully comparable to the gauge's compression ratio of $2{\cdot}4 \times 10^{-7}$. The methods of construction can be applied advantageously to small as well as to large McLeod gauges. At pressures of 10^{-2}, 10^{-3}, 10^{-4}, and 10^{-5} mm. of Hg, the precision of this gauge is 0·2, 0·6, 2, and 6% respectively. AUTHOR.

See also Abstracts 2139.

RELATIVITY AND ETHER.

1934. Physical Principles of Special Theory of Relativity. N. Barbulescu. *Phys. Zeits.* 40. *pp.* 140–141, *Feb.* 15, 1939.—Transformation equations, structurally the same as those in Einstein's theory are deduced by postulating (1) absolute time and (2) a relative velocity of light propagation. **C. F. v. Weizsäcker** (*p.* 141), in a short note, draws attention to experimental consequences of the proposed theory which differ from those of Einstein's theory. J. S. G. T.

1935. Dynamical and Field Forces. E. Esclangon. *Comptes Rendus,* 208. *pp.* 685–689, *March* 6, 1939.—The author finds the possible forms for the acceleration in two dimensions of a moving particle in terms of Lorentz coordinates in flat space, the two components of acceleration being assumed to be functions of the velocities alone. [See also Abstract 988 (1939).] G. C. McV.

1936. Theory of "General" Relativity and Astronomical Observations. G. Tiercy. *Arch. des Sciences,* 20. *pp.* 205–224, *Sept.–Oct., and pp.* 290–306, *Nov.–Dec.,* 1938.—The author discusses at length the perihelion of Mercury in the Schwarzschild field

$$ds^2 = \left(1 - \frac{2M}{c^2 r}\right)dt^2 - dr^2\Big/\left(1 - \frac{2M}{c^2 r}\right) - r^2(d\theta^2 + \sin^2\theta\, d\phi^2).$$

He claims that in these calculations a " universal astronomical time " must be identified with a " cosmic time." The latter is defined on p. 208 as " the time indicated by a clock at rest at infinity " and on p. 291 as " the time indicated by an arbitrary clock placed in any position." If the t of the Schwarzschild field is identified with the universal astronomical time T, apparently on the ground that both are cosmic times according to the first definition, the usual advance of 43″ in the perihelion is found. If however T is identified with the earth's proper-time, apparently using the second definition of cosmic time, an advance of 26″ is found which becomes 39″ when allowance is made for the special relativity dilatation of time with velocity. Incidentally no proof is given that the formulæ of special relativity which assume flat space are valid in the Schwarzschild field, but it is asserted that this velocity correction ought also to be made in the identification of t and T which would give 64″ for the perihelion advance. G. C. McV.

1937. Difficulties Underlying the Einstein-Eddington Conception of Curved Space. A. Eagle. *J. of Trans. of Victoria Inst.* 70. *pp.* 177–200, 1938.—The author attacks violently the concept of curved space on the ground that he finds it " incomprehensible " and a " deplorable episode of absurdity in the history of science " (p. 190). He regards it as obvious that space is Euclidean and is prepared to accept the Lorentz contraction of a measuring rod with velocity and a similar contraction with direction in a gravitational field as " comprehensible " whilst giving no indication on what physical experiments the existence of such contractions is to be based. In discussing the Schwarzschild field he speaks of the proper-length of a measuring rod and its coordinate-length as if they were the same thing. The author also suggests that Einstein's theory tries to " explain " gravitation and does not merely describe gravitational phenomena regarded as given. He strongly attacks such an " explanation." It should be said that the author only quotes from, and gives references to, popular or semi-popular books on relativity. G. C. McV.

1938. Two Cases of Exact Gravitational Fields with Axial Symmetry. B. C. Mukherji. *Calcutta Math. Soc., Bull.* 30. *pp.* 95–104, *Sept.–Dec.*, 1938.—Forms of the line element for an electric current in an infinite straight wire and for an electrically-charged infinite straight wire, taking into account, in each case the fields due respectively to the matter of the wire and to the current or electric charge, are derived. The solutions are admissible for zero limiting values of the current or charge but not for zero limiting value of the matter of the wire. J. S. G. T.

1939. Quantum Theory of Gravitation. A. Kaliviaris. *Phil. Mag.* 27. *pp.* 453–467, *April*, 1939.—The connection of gravitational theory with quantum mechanics is here illustrated by applying the principle of the existence of a gravity current and charge. The linear equations of the gravitational field are constructed relativistically throughout. An expression for the gravitational constant γ is given by means of atomic constants as h, c, N, and m_0. The interaction of both gravitational and electromagnetic fields is expounded in the frame of quantum mechanics, whereas the cosmological case is taken into account in analogy with the theory of atomic nuclei. AUTHOR.

See also Abstracts 1930, 2244.

SOLUTION.

1940. Molecular Forces and Solvent Power. R. G. Larson and H. Hunt. *J. Phys. Chem.* 43. *pp.* 417–423, *April*, 1939.—The solubility values for the iodides, bromides, and chlorides of Na and K in the solvents methanol, ethanol, 1-propanol, 1-butanol, 2-propanol, 2-methyl-1-propanol, 1-pentanol, and 2-butanol have been accurately determined at 25° C. The dielectric constants of the alcohols were determined by the heterodyne beat method. The phenomenon of solubility was correlated in a qualitative manner with the physical constants of solvent and solute. AUTHORS.

1941. Increasing Solubility of Oils in Water-Soap Systems. H. N. Holmes. *J. Phys. Chem.* 43. *pp.* 495–498, *April*, 1939.—It is shown that pine oil in proper proportions greatly increases the known solubility of paraffin oils in water containing sufficient sodium oleate. Optimum proportions for producing perfectly transparent, stable solutions are 1, 4, 4, 4 and 1, 2, 2, 2 parts by weight of sodium oleate, water, pine oil (the oxidised type), and kerosene. This means that a given weight of water (containing sodium oleate) can dissolve twice its own weight of the two oils. With benzene as hydrocarbon the optimum proportions are 1, 8, 8, 2 parts by weight. AUTHOR.

1942. Solubility of High-Molecular Substances. G. V. Schulz. *Zeits. f. phys. Chem.* 184. *Abt.A.* 1. *pp.* 1–41, 1939.—The osmotic pressure and vapour pressure lowering of solutions of nitrocellulose in acetone have been determined over the concentration range 0·1–75 %, the free energy of the acetone in the solution being determined from the results. Two concentration ranges can be distinguished. In the A range (0·1–5 % nitrocellulose) the dilution entropy, Δs_1, is equal to the mixing entropy, and the difference between the free energy of the solvent from the ideal is equal to the heat of dilution (Δw_1). In the B range (20–75 % nitrocellulose) the free energy of the solvent is independent of the molecular weight of the nitrocellulose. The $T\ \Delta s_1$ term is also negligible with respect to Δw_1. The taking up of the solvent by the swelling of nitrocellulose gel is thus determined almost entirely by the force of interaction between the molecules of the two compounds. The taking up of acetone by nitrocellulose is a molecular and not a capillary process. A. J. M.

See also Abstracts 1895, 2210.

SURFACE PROPERTIES.

1943. Heat of Adsorption of H_2 on Pt. L. Maidanowskaja and B. Bruns. *Acta Physicochimica*, 9. 6. *pp.* 927–941, 1938. *In German.*—Absorption isotherms are determined at 100, 120, 140 and 160° C. for H_2 on Pt. (in a finely divided state on silica gel). Heats of adsorption are calculated for different quantities of adsorbed gas. The values obtained decrease from 18 to 15 kg. cal./mol. as the quantity of absorbed gas increases from 0·178 to 0·355 millimol./gm. of adsorbent. L. A. W.

1944. Sorption of Gases on Reduced Nickel. Part I. H_2, O_2 and HBr. M. Takebayashi. *Chem. Soc., Japan, Bull.* 14. *pp.* 47–53, *Feb.*, 1939. *In English.*—In successive experiments H_2, O_2 and HBr are put into contact with reduced Ni at 20° C. and 1 atm., and the amounts of gas taken up are measured as a function of the time. The H_2 is adsorbed slowly and can be partially removed by evacuation. The taking up of O_2 is completed in a few minutes and an oxide layer is probably formed. The reduction of this layer can apparently be effected partially by H_2 at room-temperature. The adsorption of HBr extends over hours; it is greater in extent if the Ni has previously taken up O_2. L. A. W.

1945. Rate of Sorption of Gases on Porous Solids. E. Wicke. *Kolloid Zeits.* 86. *pp.* 167–186, *Feb., and pp.* 295–313, *March,* 1939.—From determinations of the distribution of pure radii it is inferred that the inner volume of active charcoal consists of two pore systems having mean radii 10^{-4} cm. and 10^{-7} cm. respectively. The structure is granular, each grain being permeated by the micropores whilst the intergranular spaces constitute the macropores. In contrast silica gel shows a continuous distribution of pore radii and resembles a network of veins. Results for the rate of static sorption of CO_2 by charcoal at 1 mm. pressure have been quantitatively explained in terms of transport through the macropores coupled with diffusion into the micropores. At higher pressures (100 mm.) complications due to temperature changes up to 20° resulting from heat of sorption obtrude, nevertheless a quantitative expression for sorption rate has been developed by taking into account the rate of transport of heat to and from the adsorbent. Dynamic sorption has been studied by streaming CO_2, with N_2 as carrier gas, through layers of the adsorbent, and plotting concentration of issuing gas against time of streaming. Adsorption yields S-shaped curves which can be represented by a theoretical expression, but desorption gives unsymmetrical flat curves capable only of empirical representation and indicating that desorption is much slower than adsorption. During dynamic sorption, thermal effects are negligible. S. J. G.

1946. Application of Statistical Methods to Immobile Adsorbed Films. J. K. Roberts and A. R. Miller. *Cambridge Phil. Soc., Proc.* 35. *pp.* 293–297, *April,* 1939.—Bethe's method is applied to determine statistically the rate of condensation of diatomic molecules which are adsorbed with dissociation to form an immobile film, the two atoms of one adsorbed molecule occupying two neighbouring sites. A lower limit to the number of gaps, or isolated unoccupied sites, in the final film is also obtained. The results calculated statistically agree with those obtained earlier by using models. [See Abstract 3546 (1938).] AUTHORS.

1947. Separation of Hydrocarbons of High Molecular Weight by Adsorption on Silica Gel. C. B. Willingham. *Bureau of Standards, J. of Research,* 22. *pp.* 321–327, *March,* 1939.—Data are presented on the separation of different types of hydrocarbons of high molecular weight by adsorption on silica gel. A sharp separation of 5-(7-tetrahydronaphthyl)-docosane from 5-(2-decahydronaphthyl)-docosane, and *n*-dotriacontane from 1-(*p*-diphenyl)-octadecane was obtained. Some separation of 1-(*p*-diphenyl)-octadecane from 5-(7-tetrahydronaphthyl)-docosane was found, but the separation was not as sharp as with the two preceding mixtures. No separation of a mixture of *n*-dotriacontane and 5-(2-decahydronaphthyl)-docosane was found. The capacity of 20 gm. of silica gel to absorb preferentially the more aromatic components of these mixtures was found to be 1·8, 3·3, and 0·8 gm. respectively, for the first three mixtures listed above. AUTHOR.

1948. Adsorption of Water by Papers at Elevated Temperatures. C. C. Houtz and D. A. McLean. *J. Phys. Chem.* 43. *pp.* 309–321, *March,* 1939.—The apparatus employed to obtain sorption isotherms is described, with particular attention to two methods of measuring the quantity of water admitted to the adsorbent. Adsorbent isotherms for water on two types of cellulosic tissue, one of linen derivation and the other of wood pulp, have been obtained for temperatures from 100° C. to 150° C. and for equilibrium water vapour pressures from 0 to 25 mm. of Hg. The Freundlich adsorption equation is found to apply to the isotherms in the ranges studied. A table of the calculated constants is presented. Hysteresis between adsorption and desorption equilibria is found under the conditions of the experiment, but no quantitative data are presented. Drying paper at temperatures higher than the temperature at which adsorption is subsequently measured is shown to cause a large diminution in the adsorption at the temperature of measurement. Tentative values for the heats of adsorption are calculated by means of a modification of Freundlich's heat of adsorption equation, and curves are presented for the heats of adsorption on wood pulp paper with respect to the quantity absorbed. AUTHORS.

1949. Effect of Electrolytes upon the Interfacial Tension between Water and Dekalin. W. L. Guest and W. C. M. Lewis. *Roy. Soc., Proc.* 170*A*. *pp.* 501–513, *April* 21, 1939.—The interfacial tension between dekalin (*trans*-decahydronaphthalene) and aqueous solutions of the following salts has been determined as a function of concentration at 25° C.: KCl, LiCl, $BaCl_2$, $LaCl_3$, $ALCl_3$, KI, KSCN, LiI, and LiSCN. The last four salts are capillary active in the sense that the interfacial tension falls with increase in concentration of the active individuals, namely iodide and thiocyanate ions. Such capillary activity is specific, there being no theoretical explanation available at the present time to account for the behaviour. Of the five chlorides examined, two of them, namely LiCl and $LaCl_3$ exhibit a minimum in interfacial tension in the dilute region followed by a rise beyond that given by water alone in contact with dekalin. The existence of the minimum is accounted for, in a formal manner at any rate, by the theory advanced by Dole [see Abstract **2734** (1938)] to account for the minimum observed by Jones and Ray at a region of still greater dilution ($0{\cdot}001\ N$) in the case of simple salts at the air-water surface. In the case of KCl and $BaCl_2$ which apparently do not exhibit a minimum, the influence exerted upon the interfacial tension is so minute (at great dilution) that the existing experimental technique is not sufficiently precise to permit of the application of the theory of Dole. In the region of higher concentration where the chlorides referred to exhibit an increase in tension with increase in concentration the discrepancy between the values observed and those calculated (either on the theory of Dole or on that of Wagner-Onsager-Samaras) is similar to that exhibited by simple salts at the air-water surface. AUTHORS.

1950. Adsorption in the Solid Phase. S. Dobiński and A. Jagielski. *Acad. Polonaise Sci. et Lettres, Bull.* 8–10*A*. *pp.* 423–427, *Oct.–Dec.*, 1938. *In English.*—The structure of the surface of a few alloys was examined. Adsorption of some alloying elements on the surface has been demonstrated. The phenomenon is interpreted as a result of differences in the surface tension of solid metals. Using T, with an index, to denote the surface tension of a metal, the results may be summarised in the form of the following inequalities: $T_{Sb} < T_{Pb}$, $T_{Sn} < T_{Zn}$, $T_{Ca} < T_{Cu}$, $T_{Ca} < T_{Ag}$. If the results obtained on ternary and quaternary alloys are to be taken into account the following inequalities are to be added: $T_{Al} < T_{Cu}$, $T_{Al} < T_{Ni}$, $T_{Mg} < T_{Al}$, $T_{Mg} < T_{Cu}$, $T_{Mg} < T_{Ni}$. [See also Abstract 128 (1939).] AUTHORS.

1951. Electron-Diffraction Study of Thin Films of Cellulose Derivatives. J. Kakinoki. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 66–74, *Feb.*, 1939. *In English.*—A preliminary report is made of an investigation of the three diffuse haloes which are obtained by electron diffraction from thin cellulose films, when these are sufficiently pure to eliminate the patterns found in the presence of very slight traces of impurity. Interpretations of the three haloes are attempted both from the standpoint of imperfections in the crystal lattice, and from the standpoint of the amorphous state of macro-molecules. The latter interpretation accounts fairly well for the experimental facts, and gives important information as to the structure of the cellulose derivatives. E. E. W.

1952. Single-Crystal Palladium Films and their Interaction with Gases. S. Fordham and R. G. Khalsa. *Chem. Soc.*, *J. pp.* 406–412, *March*, 1939.—The lattice constant of Pd leaf was referred by electron diffraction to $a = 2{\cdot}456$ Å for graphite, and found to be $3{\cdot}894 \pm 0{\cdot}005$ Å. (by X-rays, $3{\cdot}882$ Å.). Evaporation of Pd on the rock-salt cleavage surfaces between 350° and 450° gave specimens with the [100] axis of the Pd parallel to the [110] axis of the rock-salt, a second axis of orientation occurring simultaneously in most cases, resulting in "single-crystal" specimens. Above 450° the Pd oriented itself with its planes parallel to the similar planes of the substrate. A tentative explanation is advanced for these orientations. Heat treatment in a vacuum at temperatures up to 800° caused no change in the diffraction patterns. Oxidation at 600°

gave palladous oxide with its [210] axis parallel to the [110] axis of the metal, but specimens partly oxidised and then annealed had the (100) and (001) faces of the former parallel to the (110) and (001) faces respectively of the latter. The oxide was tetragonal with $a = 3 \cdot 05$ Å and $c = 5 \cdot 28$ Å. Heat treatment of Pd or Pt in pure H_2 or NH_3 above 500° caused the 100 and 110 diffractions to appear; this is ascribed to the replacment of metal atoms by H-ions at statistically distributed points of the lattice. AUTHORS.

1953. True Structure of Thin Gold Films and Structure as Shown by Electron Diffraction. D. A. Was. *Physica*, 6. *pp.* 382–389, *April*, 1939. *In English.*—It is demonstrated that the electronic-ray diagrams obtained from amorphous gold films invariably show the normal metal pattern, owing to the fact that the electrons cause a transition of the original film into a crystallised one. [See Abstract 4029 (1937) and following Abstract.] AUTHOR.

1954. Electrical Conductivity, Light Transmission and Structure of Thin Gold Films. D. A. Was. *Physica*, 6. *pp.* 390–392, *April*, 1939. *In English.*—The electrical conductivity and the light transmission of Au films of various thicknesses were measured. The results show that these films are amorphous so long as their thickness is below a critical value; beyond this value of the thickness they show crystallisation. This critical thickness is increased by outgassing the carrier-layer and appears to be the same in the case of quartz as in that of glass. The velocity of crystallisation differs for the two carrier-layers. Films of gold on non-outgassed glass and quartz, show a different critical thickness. A parallelism exists between the power of transmission of light and the electrical conductivity. The results are explained as being due to the adhesion forces between the gold atoms and the carrier-layer. [See preceding Abstract.] AUTHOR.

1955. Production and Structure of Electrolytic Al_2O_3 Layers. W. Baumann. *Zeits. f. Physik*, 111. 11–12. *pp.* 708–736, 1939.—The effect of the nature of the electrolyte on the structure of Al_2O_3 layers produced electrolytically has been examined, and in particular the type of layer which has a moderate solubility in the electrolyte. In this case the oxide formed largely redissolves with the preliminary formation of pores within the layer. The speed of dissolution of the material of the layer in the electrolyte in which it is produced determines the type of layer. The pores were examined microscopically. The higher the potential under which they are deposited, the larger is the diameter of the pores. Pores produced by a.c. are finer than those produced by d.c. The mechanism of the formation of oxide layers by electrolysis is discussed. A. J. M.

1956. Artificial Surface Layers on Glass. A. Vašiček. *Kolloid Zeits.* 86. *pp.* 288–295, *March*, 1939.—The presence of a surface layer on glass was inferred and its thickness calculated from the difference in the refractive index as measured polarimetrically and by the method of minimum deviation respectively. Four hours immersion in *N* H_2SO_4 produced a surface protective layer *ca.* 10^{-4} mm. thick, by chemical action of the acid on the constituents of the glass. The layer was resistant to further attack by H_2SO_4 or NaOH. Four hours immersion of fresh glass in *N* NaOH yields no protective layer, but corrodes the surface which is now more easily attacked by H_2SO_4 also. Crown glass is more rapidly attacked by both reagents than flint glass, whilst quartz is unaffected. S. J. G.

1957. Interaction between Adsorbed Substances of Simple Constitution and Insoluble Monolayers. N. K. Adam, F. A. Askew and K. G. A. Pankhurst. *Roy. Soc., Proc.* 170*A. pp.* 485–500, *April* 21, 1939.—The interaction between simple capillary active solutions and insoluble monolayers has been studied by measuring the surface pressure and surface potential of the insoluble monolayers put on the surface of the solutions. Equilibrium is established practically instantly. Penetration generally, but not invariably, occurs at surface pressures of the order a few tenth of a dyne per cm., phenol having, as a rule, the greatest penetrating power, butyric acid, the next, and butyl alcohol the least, of these three capillary active solutes. The principal result of penetration is to disrupt the cohesion of the insoluble film, turning a normally coherent film into a vapour expanded or gaseous one. Penetration may continue up to much higher surface pressures, but more frequently, when the film is compressed, penetration diminishes or ceases altogether, and the adsorbed film is then usually displaced more or less completely from the surface by the insoluble film. No evidence has been found of stoichiometric complex formation between the adsorbed and the insoluble molecules in these cases ; and the evidence of specific interaction between the active groups in the insoluble and the adsorbed film is in these cases very scanty. AUTHORS.

1958. Calculation of Surface Viscosity from Experiment. J. J. Hermans. *Physica,* 6. *pp.* 313–320, *April,* 1939. *In English.*—If a monolayer on a liquid flows through a canal under the influence of a pressure gradient it drags away a certain amount of the substrate. Consequently, both the surface viscosity μ and the viscosity λ of the substrate play a part in this phenomenon. Harkins and Kirkwood obtained a formula for the surface flux in the case of a rectangular slit. It is shown that their formula also applies to a canal formed by two mica plates resting on the surface. This can to some extent to justified by a closer theoretical investigation if it be assumed that the solution of the problem may be expanded in powers of λ. AUTHOR.

1959. Film Potentials of Stearate Multilayers and Other Dielectrics on Metal Surfaces. W. D. Harkins and R. W. Mattoon. *J. Chem. Phys.* 7. *pp.* 186–197, *March,* 1939.—Part if not all, of the film potential of an X multilayer of calcium stearate on a subphase of metal is believed to be due to a surface charge on the dielectric and a resultant induced charge in the metal. The potential of a Y multilayer of an even number of layers is almost zero. It is considered that the surface of the multilayer becomes charged only when it moves through the surface of the solution without the deposition of a new layer. When X layers are deposited directly on the metal, the film potential is proportional to the number of layers, which suggests a charge on the outer surface only. In the case of X layers deposited on a subphase of (X + Y) layers, the potential increments are nearly constant for each successive X layer—a result which is not in agreement with equations developed for a constant charge on the outer X layer only, or on every X layer. The film potential is found to be a function of the pH of the subsolution and the nature of the positive ions. E. R.

***1960. Surface Tension Manometer with Pendulum Suspension. J. Guastalla.** *Comptes Rendus,* 208. *pp.* 973–975, *March* 27, 1939.—

The arrangement consists of a suitably shaped and attached strip of material floating on the surface concerned so as to be pushed by the film thereon which is suitably compressed. The strip is attached to a light brass piece suspended in pendulum fashion from above in such a way that the force with which it is pushed by the film is measured by the deviation of the brass piece from the vertical. C. A. S.

See also Abstracts **1874, 1875, 1876, 1882, 1888, 1891, 2021, 2207, 2215.**

TIME.

***1961. Falling-Weight Time Switch and Time Constant of Inductive Circuit. E. J. Irons and G. A. Bennett.** *Phys. Soc., Proc.* 51. *pp.* 459–464, *May,* 1939.—In this apparatus the simultaneous release of two spheres, one from a fixed height and the other from a known but variable height H, causes two switches to be thrown so that the time interval between their operation is a linear function of $\sqrt{H}$. The apparatus is tested by a condenser-discharge method which affords a determination of g with an accuracy of about 0·5%. The use of the device is illustrated by a study of current growth in an inductive circuit for which the time constant is deduced. AUTHORS.

VISCOSITY AND FRICTION.

1962. Viscosity of Dilute Solutions of Long-Chain Molecules. Part II. M. L. Huggins. *Kodak Research Lab., Comm. No.* 690. *J. Phys. Chem.* 43. *pp.* 439–456, *April,* 1939.—Theoretical derivations have been given for the previously reported general equation relating the viscosity of a dilute solution to the coordinates and sizes of the atoms in the component molecules, and also for the special equations applying to rigid chain molecules which are rod-like or are randomly kinked. The difficulty of determining theoretically the " effective radius " of a group of atoms in a chain molecule, for use in these equations, has been briefly discussed. Long, randomly kinked chains should obey Staudinger's empirical " law." Long rod-like molecules should show a very great dependence of viscosity on the velocity gradient in the solution. [For Part I see Abstract 4830 (1938).] AUTHOR.

***1963. Viscosity of Liquid He II. W. F. Giauque, J. W. Stout and R. E. Barieau.** *Am. Chem. Soc., J.* 61. *pp.* 654–661, *March,* 1939.—The flow of liquid He through small channels has been studied to obtain data desired in connection with the design of apparatus for adiabatic demagnetisation experiments. Formulæ have been developed for the case of isothermal laminar flow when the material enters as a liquid and leaves as a gas. The viscosity of liquid He was found to decrease from $2 \cdot 0 \times 10^{-5}$ poise at 2·266° K. to $1 \cdot 0 \times 10^{-7}$ poise at 1·468° K. The largest Reynolds number, which occurred at 1·468° K., was estimated to be about 200. At the lowest temperature of measurement the viscosity is still decreasing rapidly and appears to be approaching a value of zero at the absolute zero of temperature. AUTHORS.

See also Abstracts **1865, 1866, 1879, 1958, 2152.**

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1964. Celestial Kinematography. R. M. Petrie.** *Roy. Astron. Soc., Canada, J.* 33. *pp.* 33–38, *Feb.*, 1939.—The author describes the evolution of motion-picture cameras directly attached to a telescope, from 1927 to the present time: for shadow changes in lunar craters; Jupiter's belts; stellar occultations by the moon; the solar eclipse of 1932; and, especially, rapid solar changes. This last has proved a valuable research, with special problems of technique, since the final projected picture is greatly magnified, and a following rather than a guided telescope is required. On the moon the "terrain" near mountains and crater walls can be explored, and proper levels found; on the sun, the short-lived spots, prominences, and granules can be examined together. There are two plates given. A. S. D. M.

COMETS AND METHODS.

1965. Widmanstätten Structure of Octahedral Meteoric Iron. S. W. J. Smith and J. Young. *Nature*, 143. *pp.* 384–385, *March* 4, 1939.—Widmanstätten structure occurs only in meteoritic Ni-Fe containing $> 6\cdot5\%$ Ni, and containing both kamacite and taenite, those with less Ni containing only kamacite. Thermomagnetic analysis shows that taenite has a reversible magnetic transition temperature at 500°, and contains about 50% Ni. Both it and kamacite are solid solutions, and X-rays show the former has a face-centred, kamacite a body-centred lattice. Careful annealing at 580° and very slow cooling gave indications of Widmanstätten structure in a Ni-Fe alloy containing 10% Ni. This would probably have been more distinct with slower cooling. The structure appears to be due to formation of kamacite lamellæ as a result of a γ-α-lattice mechanical transformation in the taenite. C. A. S.

See also Abstract 2103.

COSMOGONY.

See Abstracts 1970, 1973, 1993.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1966. Tables of Two Chief Laplace Coefficients. A. Fletcher. *Roy. Astron. Soc., M.N.* 99. *pp.* 259–265, *Jan.*, 1939.—Tables of the coefficients b_0 and b_1 in the expansion

$$(1 + a^2 - 2a\cos\phi)^{-1/2} = \tfrac{1}{2}b_0 + \sum_1^\infty b_n\cos n\phi$$

are given for values of a. From $a = 0$ to $a = 0\cdot75$ the table is calculated for interval 0·01 and the values of b_0 and b_1 are believed to be accurate to within one unit in the eleventh decimal place. A further table with interval 0·001 gives values of the coefficients between $a = 0\cdot75$ and $a = 0\cdot9$. Finally a table of b_0 and of $(b_0 - b_1)$ for values of a between 0·75 and 1·00 is given. G. C. McV.

LATITUDE AND LONGITUDE.

1967. Latitude Variation at Greenwich, 1911-1936, Preliminary Values, 1936-1938, and New Observing Programme. H. R. Hulme. *Roy. Astron. Soc., M.N.* 99. *pp.* 199–205, *Jan.*, 1939.—From 1911–1936, a determination was made of the zenith distances (north), with the Cookson telescope, of 69 pairs of stars, free from errors arising from an unknown variation of the latitude assumed (51° 28′ 38″·75) for epoch 1925. The author compares, for these pairs, the differences from those of the Boss General Catalogue, and finds that the latter's declinations between 34° and 70° require a correction depending on R.A. In 1936 the Cookson floating telescope was moved to a new site in the Christie enclosure. The old site was in lat. 51° 28′ 39″·04; the new site is less than 51° 28′ 38″·03 by about 0″·10. There are 148 star pairs and 36 of these were observed on the old Cookson programme. They are divided into 24 groups (of 10–18 stars), extending over one hour in R.A.; 3 groups are observed each night (about midnight) for a fortnight by one observer; in the old programme, the observations were made at 6 a.m. and 6 p.m., which involved two observers. A diagram and table show the results. A definite "wind effect" is apparent at the new site, the residuals being about 0·07 greater for N than for S winds. [See following Abstract.] A. S. D. M.

1968. Constant of Nutation. H. Jeffreys. *Roy. Astron Soc., M.N.* 99. *pp.* 206–210, *Jan.,* 1939.—The author discusses points in Spencer Jones' redetermination of nutation [see following Abstract] as to the validity of the estimated uncertainty in counting two sets when parts of the data are common to both. He deals with the matter in terms, entirely, of intercorrelation, and connects the unexplained variation with an irregular variation of the diurnal variation of latitude. The reduction of the residuals at this stage indicates that, subject to the latter variation being known, the nutation residuals can be treated as accidental and the apparent uncertainty is valid. He suggests various tests; one of his own and Fisher's *z* test. He also suggests the abandonment of "probable errors." [See preceding Abstract.] A. S. D. M.

1969. Determination of Constant of Nutation from the Greenwich Latitude Variations (Second Paper). H. Spencer Jones. *Roy. Astron. Soc., M.N.* 99. *pp.* 211–216, *Jan.,* 1939.—In the first paper [see Abstract 2756 (1938)] it was assumed that the constant of nutation found (9″·2173) must be free from systematic errors, but there did emerge such an effect due to a fluctuation from year to year, which is not accidental, and varies with the R.A.; a term therefore of the form S sin $(\theta - \alpha)$ was introduced to take account of this diurnal variation of latitude. The constant of nutation now becomes 9″·2134 ± 0″·0042 instead of 9″·2173; the reciprocal of the moon's mass becomes 81·64 or 81·70 according as the basis is taken from Newcomb's or from Oorts' value of the lunar-solar precession, and these values have a probable error of ± 0·12. [See preceding Abstract.] A. S. D. M.

NEBULÆ.

1970. Origin of Great Nebulæ. G. Gamow and E. Teller. *Phys. Rev.* 55. *pp.* 654–657, *April* 1, 1939.—The formation of condensation due to gravitational instability is discussed in a uniformly expanding space. It is shown that such condensations cannot be formed at the present stage of the development of the universe but could have been formed in the past when all linear dimensions were 600 times smaller. This corresponds to the stage at which, according to astronomical observations, nebulæ have been separated from each other. To get the correct dimensions of nebulæ it is necessary to accept that the velocities of particles at the moment of separation were about 140 km./sec. which strongly suggests that these particles were stars and not atoms. The type of expansion necessary for the formation of nebulæ indicates that space is infinite and unlimitedly expanding. Authors.

PLANETS.

1971. Heterochromatic Photometry and Colour Indices of Neptune and Vesta. L. Gialanella. *Accad. Lincei, Atti*, 28. *pp*. 325–330, *Nov*. 19, 1938.—The author has measured the colour indices of Neptune and Vesta with a wedge-photometer provided with three coloured (yellow, violet and red) filters. The absorption of these filters was known. The instrument was calibrated by measuring the colour indices of stars contained in Öpik's catalogue. A diagram is given connecting the colour indices and the difference of the photometer readings for the yellow and violet filters. The colour index of Neptune was investigated in March and April, 1938, and that of Vesta in May and June, 1938. The values obtained are: + 0·653 ± 0·006 for Neptune and + 0·838 ± 0·006 for Vesta. L. K.

1972. Gaps in the Ring of Asteroids Regarded as Resonance Phenomena. H. Fabre. *Comptes Rendus*, 208. *pp*. 730–732, *March* 6, 1939.—The differential equations for the motion of a small asteroid under the influence of the planet Jupiter show that four unstable zones exist in which the orbit cannot lie. G. C. McV.

1973. Moon and Earth. B. G. Escher. *K. Akad. Amsterdam, Proc*. 42. 2. *pp*. 127–138, 1939. *In English*.—The theory of the origin of the moon preferred is that it occurred through resonance within 10,000 years of the earth's birth, at a time when, through magmatic differentiation and cooling, an outer shell (35 km. thick) of viscous granitic magma (*d* 2·37) had formed, with denser (*d*. 2·67) basaltic magma below, in which still denser material and some Ni-Fe (*d* 8·0) were mixed. Of the granite shell 66 % was flung off with some denser material to form the moon. The moon consists of granite magma 53 %, basaltic magma 38 %, and Ni-Fe 9 %, or possibly in place of part of the basaltic magma some peridotitic (*d* 3·234), dunitic (*d* 3·289), or lhertzolittic (*d* 3·330). The continents originated at the same time from the broken up remnants of the granitic shell floating on the denser basaltic magma, which would tend to come together. The lunar craters are due mainly to expulsion (with greater effect) of gas from the very gaseous granitic magma consequent on the reduction of gravity, which on the moon is only 1/6th of the terrestrial. C. A. S.

See also Abstracts 1964, 1967, 1968, 1969.

STARS.

1974. Calculation of Rotation Factors for Eclipsing Binaries. R. M. Petrie. *Dominion Astrophys. Obs. Victoria, B.C., Publ*. 7. 6. *pp*. 133–139, 1938.—The calculation of " rotation factors " is required in the application of rotation-effect, determinations of orbital dimensions. Previous methods rely upon graphical computation. In this paper integrals are set up to define the "rotation factor" and solved to give formulæ for the computation. Spherical and ellipsoidal cases are treated, assuming the stellar discs to be uniformly bright. Author.

1975. Definitive Orbit of Spectrographic Binary β Arietis. R. M. Petrie. *Dominion Astrophys. Obs. Victoria, B.C., Publ*. 7. 3. *pp*. 105–114, 1938.—The orbital elements are derived from 134 spectrograms made at the Michigan, Yerkes, and Victoria Observatories. The elements are determined with a high degree of precision and compared with elements derived from Potsdam observations thirty years earlier. There appears to be no change in the orbit. AUTHOR.

1976. Spectrographic Orbit of H.D. 195986. A. McKellar. *Dominion Astrophys. Obs. Victoria, B.C., Publ.* 7. 4. *pp.* 115–120, 1938.—46 spectrograms, of which 7 were obtained from 1924 to 1928 and the remainder in 1937, form the basis of the calculation of the spectrographic orbit of the star H.D. 195986. The orbital elements are computed to be $P = 5 \cdot 38275$ days, $e = 0 \cdot 069$, $V_0 = -16 \cdot 88$ km./sec., $K = 31 \cdot 68$ km./sec., $\omega = 57^\circ 1$, and T = J.D. 2,428,755·557. The K-line of Ca II in the spectrum of this star, which is of type B6s, is shown to be blended, being partly of stellar and partly of interstellar origin. AUTHOR.

1977. Spectrographic Orbit of Boss 3511. W. E. Harper. *Dominion. Astrophys. Obs. Victoria, B.C., Publ.* 7. 7. *pp.* 141–147, 1938.—142 spectrograms of this star obtained at Victoria in the years 1920 to 1937 form the basis of the determination of the orbit. The orbital elements are computed to be $P = 2 \cdot 61314$ days, $e = \cdot 040$, $V_0 = +6 \cdot 43$ km./sec., $K = 9 \cdot 48$ km./sec., $\omega = 214^\circ \cdot 76$ and T = J.D. 2,417,022·522. The probable error of a plate is $\pm 1 \cdot 4$ km./sec. AUTHOR.

1978. Origin of Coloration of "Yellow" B-Stars and cB-Stars. W. Becker. *Zeits. f. Astrophysik,* 18. 1. *pp.* 25–44, 1939.—Colorimetric observations of the satellites and neighbouring stars of 12 "yellow" B-stars and coloured cB-stars show that the coloration must be ascribed entirely to selective interstellar absorption. From a statistical investigation of apparently close pairs of stars and star groups of early spectral type it is shown that this conclusion can be generalised; in 200 such stars considered no exceptional cases are found. J. E. K.

1979. Interstellar Coloration as a Means of Determining Absolute Brightnesses of CB-Stars and other Objects. W. Becker. *Zeits. f. Astrophysik,* 18. 1. *pp.* 45–48, 1939.—An established relationship between colour excess and distance permits deduction of the absolute brightness of a star from observation of its colour excess. This method is applied to cB- and cA-stars and gives a mean visual absolute brightness of $-4^m \cdot 80 \pm 0^m \cdot 15$. J. E. K.

1980. Equilibrium of Distorted Polytropes. Z. Kopal. *Roy. Astron. Soc., M.N.* 99. *pp.* 266–271, *Jan.*, 1939.—The structure of a tidally distorted gaseous sphere depends on the solution of the equation $\nabla^2\theta = -\theta^n$. It is shown that for the case $n = 1$ the equation can be solved in finite terms. G. C. McV.

1981. Rotation Effects, Interstellar Absorption and Certain Dynamical Constants of the Galaxy Determined from Cepheid Variables. A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 607. *Astrophys. J.* 89. *pp.* 356–376, *April,* 1939.—The radial velocities of 156 variable stars of the δ Cephei type are available for a determination of the rotation of the galaxy, the coefficient of interstellar absorption, and certain galactic constants. The δ Cepheids are situated close to the plane of the galaxy, and as seen from the earth, they are well distributed in longitude. The known stars of this type are considerably clustered about the sun. The distances used are determined from apparent magnitudes and absolute magnitudes derived from the period-luminosity curves. In order that the rotation effect may show a linear relationship with distance, it is found necessary to correct the distances by postulating the presence of interstellar absorption. The coefficient of absorption is estimated to be 0·85 mag./kpc. and the absorbing material is assumed to be uniformly distributed about the galactic plane in a layer having a total thickness of 0·4 kpc. For a study of galactic rotation the stars are divided into four distance groups. Solutions by Oort's method give for l_0, the longitude of the direction of the centre of rotation, 325·3° ± 1·3°, and for A, the rotation effect at one kiloparsec., 20·9 ± 0·8 km./sec. The distance to the centre is estimated to be 10 kpc. By the use of Bottlinger's formula the circular orbital velocity of the sun is found to be 296 km./sec. and the period 207,000,000 years. After taking out the effect of a solar motion of 20 km./sec. and circular rotational effects, the average residual radial velocity is 10·8 km./sec. AUTHOR.

1982. 132 New Variable Stars in Five Globular Clusters. H. B. Sawyer. *Dominion Astrophys. Obs. Victoria, B.C., Publ.* 7. 5. *pp.* 121–131, 1938.—From a study of 252 Newtonian plates, 132 new variable stars have been found in 5 globular clusters, increasing by 10% the number previously known in such objects. The totals for the 5 clusters are as follows: N.G.C. 6218, 1; N.G.C. 6254, 2; N.G.C. 6402, 72; N.G.C. 6934, 51; N.G.C. 7089 (previously published) 6. In the first four of these clusters no variables were known previously. N.G.C. 6402 and 6934 are among the richest clusters in the sky in their percentage of variable stars. Most of the new variables will prove to be cluster type Cepheids, but some, in N.G.C. 6218, 6254, and 6402, are definitely long-period Cepheids. AUTHOR.

1983. Photographic Photometry and Colorimetry of Eclipsing Binary Star β-Lyræ. H. Grouiller. *Comptes Rendus*, 208. *pp.* 633–635, *Feb.* 27, 1939.—β Lyræ is a prototype of the variable binaries whose components are ellipsoidal giant stars. Its spectrum is double; one normal (B8 or B9) and one abnormal (B5e or B2e), the latter indicating an expanding nebular envelope. The spectrophotometric and colorimetric conditions are investigated by two parallel series of observations, one made on Lumiere Opta plates without a screen, and one on Panchromatic Agfa Isopan super-special plates with an orange Wratten screen No. 15. The two curves given show that the most intense perturbation is near the principal minimum. Between effective wave lengths 4500–6100 Å, there is little colour variation during a revolution, the mean colour being near $0^m·05$, opposed to that of the component types, but in accord with the visual colour estimates. A. S. D. M.

1984. Spectroscopic Triple Star H.R. 6497. R. Tremblot. *Comptes Rendus*, 208. *pp.* 879–880, *March* 20, 1939.—The author finds in H.R. 6497 a replica of the triple system, 59 Serpentis [see Abstract 4403 (1938)]. This unites the characteristics of A_0 and G; but no radial velocity measure as yet published, gives the means of finding its absolute magnitude. Five spectrograms between 16 Å to near 3930 Å, indicate close analogies between these two stellar systems. The whole spectrum is of type G_0 to G_5, but the presentations of the Ca and H lines are those of A_0 and A_2. K of Ca is a double with slightly differing intensities; on 3 plates H_ϵ is complex, one component line having the same radial velocity as K_1. The difference of radial velocities between the principal star and the centre of mass is 50 km/sec. at the date of observation, indicating a period of less than year at most; and there are other analogies to 59 Serpentis. A. S. D. M.

1985. Supernovæ Spectra in IC 4182 and NGC 1003. R. Minkowski. *Astrophys.* J. 89. *pp.* 156–217, *March,* 1939.—Comparison of the supernovæ IC 4182 and NGC 1003 show great similarity in the two series of spectra and their changes; they agree best, 9 days after maximum. This uniformity holds also for the spectra of former supernovæ, S Andromedæ perhaps excepted. The spectra of the other six differ in only details, without affecting the general spectra, and the 7th (S Andromedæ) may be of the same type but with different features. This close relationship extends to the time scale of the major changes in the red and blue spectral intensities; to both the red part itself; and to the rate at which the permanent features in the blue change their wave-lengths. The red shift is a common effect in supernovæ spectra and the wave-length measurements of the blue permanent bands give a time for the reaching of the maximum of a supernova; this has no counterpart in ordinary novæ. 38 diagrams are given. A. S. D. M.

1986. New Eclipsing Variable of Large Mass. S. Gaposchkin. *Astrophys. J.* 89. *p.* 322, *March*, 1939.—Through the use of a wrong elongation angle [see Abstract 1049 (1939)] corresponding to D = $0^{p}{\cdot}085$, the dimensions of the system were incorrectly computed. The correct values of the masses are 42·5 and 39·1; for the mean radii (corrected for the ellipticity $b/a = 0{\cdot}972$), 13·40 = 0·134 Å and 12·1 = 1·123 Å; for the mean densities, 0·018 and 0·022; and for *i*, 85·5. The ordinates for the figures should be 6·54, 6·58, 6·71, 6·84, 6·96, and 7·09. With these values the system does not deviate greatly from the mass-luminosity relation. AUTHOR.

1987. Reflection Effect in Eclipsing Binary Systems. Z. Kopal. *Astrophys. J.* 89. *pp.* 323–332, *April*, 1939.—It is pointed out that the discrepancies between the observed amounts of light reflected in eclipsing binary systems and those calculated with the aid of Eddington's formula are due to the neglect of bolometric corrections. The discrepancies turn out to provide us with a possibility of determining the temperature of the reflecting layer. The effect of reflection on the apparent ellipticity constant is studied on the basis of formulæ by Milne (taking account of the darkening) and Pike; in general, the correction term is found to be positive and proportional to the sum of light reflected by both components. AUTHOR.

1988. Spectrographic Elements for β Capricorni. R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 605. *Astrophys. J.* 89. *pp.* 333–346, *April*, 1939.—Spectrograms of β Capricorni taken at Mt. Wilson prolong the interval of observation of this star to about 40 years. The Mt. Wilson observations, through their greater extension to the u.v., have revealed a short-period spectroscopic binary as the real secondary to the primary already studied and discussed by Merrill and by H. Spencer Jones. It has been possible, first, to improve all the elements of the primary, especially the period; second, to get the semiamplitude of velocity variation of the centre of mass of the short-period binary; and, third, to derive elements for the principal star of the short-period binary. The two periods involved are 1374 and 8⅔ days. Elements and functions depending upon them are given. The masses of the three stars cannot be less than 4·4, 3·9 and 0·9 ☉. How much they exceed these values depends upon the inclinations of the two orbit planes. Considerations of mass, luminosity, and spectral type seem to indicate that the inclinations probably do not differ much from 90°. AUTHOR.

See also **Abstract 2103.**

SUN.

1989. Spectra of Bright Chromospheric Eruptions From λ 3300 to λ 11500. R. S. Richardson and R. Minkowski. *Mt. Wilson Observat., Contrib. No.* 606. *Astrophys. J.* 89. *pp.* 347–355, *April,* 1939.—Photographs of five chromospheric eruptions of intensity 2 and 3 were obtained with a concave-grating spectrograph including an all-mirror optical system. The spectral regions covered were $\lambda\lambda$ 3300–4000, 3900–6900, 8000–8900, and 10000–11500. The following lines showed emission over bright eruptions on the disc; λ 10830 of He, the infra-red triplet of Ca II, the Balmer series from H_α to H_ι, and $\lambda\lambda$ 3968·494, 3933·684, 3736·919 of Ca II. Bright eruptions at the limb, in addition to the lines above, showed $\lambda\lambda$ 10938·12 and 10049·39 of H; $\lambda\lambda$ 6678·149, 5875·79, and 4471·48 of He. No emission was observed at the limit of the Balmer series. There was no evidence that black-body radiation is associated with the bright eruptions. It is pointed out that λ 584 of He may be of importance in producing variations in ionisation at high levels in the ionosphere. AUTHORS.

1990. Anomalous Solar Period, 1923-1933. H. Mémery. *Comptes Rendus,* 208. *pp.* 733–734, *March* 6, 1939.—The sunspot period, minimum to minimum, has usually 3 to 5 years to maximum and 6 to 8 years back to minimum, but one period in each century is peculiar; it is certain that for 1923–1933 (period only 10 years) the maximum was in 1928–29, and probably it was for the same epoch in the 10-year periods of 1823–33, and 1723–33; thus confirming the author's previous suggestion of a 100-year cycle for sunspots. He points out a meteorological coincidence in the *fin-de-siècle* severe winters of the 19th century. A. S. D. M.

See also Abstracts 1964, 2008, 2009, 2086, 2103, 2262.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

1991. Geological Conductors. V. Fritsch. *Gerlands Beitr. z. Geophys., Supplementband* 4. *pp.* 219–289, 1939.—The paper is a review of the electrical condition of strata. As electrical conductors their properties vary within wide limits and the conditions for conduction are complex. Moisture is the most important factor. W. A. R.

***1992. Development of Seismic Methods of Prospecting. B. Gutenberg.** *Gerlands Beitr. z. Geophys., Supplementband* 4. *pp.* 169–218, 1939.—After an historical review the author gives an account of the organisation of a field party for seismic prospecting. The refraction method and the determination of the wave velocity are then considered. The reflection method with a description of the instruments necessary is also reviewed. The author discusses the effective explosive charge and methods of detonation and gives actual examples of the use of both methods. W. A. R.

LAND, PHYSICS OF THE.

1993. N_2, A and Ne in Earth's Crust with Applications to Cosmology. (Lord) Rayleigh. *Roy. Soc., Proc.* 170*A. pp.* 451–464, *April* 21, 1939.—It is found that plutonic rocks contain N_2, A and Ne. The

N_2 appears to be mainly in chemical combination. The A and Ne are probably trapped in crystal lattices. The A found usually amounts to about 2×10^{-5} cm³./gm. The Ne is about 8×10^{-8} cm³./gm. The ratio Ne/A is of the same order of magnitude as the ratio of these gases in the atmosphere, and does not much favour the view that there has been a loss of Ne from the atmosphere. The vesicles of pumice stone contain an altogether exceptional proportion of Ne. This is difficult to understand, but can scarcely be considered to affect the general problem. Rocks in general contain about 0·04 cm³. of N_2/gm. It has hitherto been supposed that terrestrial N_2 is mainly concentrated in the atmosphere, but on the basis of the present results, the rocks probably contain in all some fifty times as much nitrogen as the atmosphere. It is no longer necessary therefore to regard the atmosphere as primitive, and no special difficulty arises as to why the earth did not lose its (dissociated) N_2 when the temperature was high. It may have lost some, but there was more in the interior. AUTHOR.

See also Abstract 1973.

METEOROLOGY.

1994. Atmospheric Ozone. D. Barbier and D. Chalonge. *J. de Physique et le Radium,* 10. *pp.* 113–123, *March,* 1939.—The observations on which the results arrived at in the present paper are based, were made during the period 1934–38. The authors in their investigations on certain stars were compelled to determine the effective thickness of the atmospheric O_3 for every night on which observations were made. Methods of determining the coefficients of absorption and of evaluating the temperature of the O_3 layer are described. Application of these is then made to the observations referred to above. As a result a definite correlation is shown to exist between the thickness and the mean temperature of the O_3, the thicker the layer the higher the temperature. An example is also given showing the very rapid variations which take place in ozone content almost as though O_3 existed in clouds. The observations were carried out at Abisko (68° 20′ N.) and at the Swiss stations of Arosa (1860 m.) and Jungfraujoch (3500 m.). A. E. M. G.

1995. Spectral Distribution of Solar Radiant Energy. H. P. Gage. *Am. Illum. Eng. Soc., Trans.* 34. *pp.* 316–326 ; *Disc.,* 326–329, *March,* 1939.—For calculating the total radiant energy transmission for sunlight at the earth's surface of heat-absorbing glasses whose spectroradiometric absorption is known, the data must also be available for the spectral distribution of radiant energy at the earth's surface. Such data have not previously been published although the necessary measurements have long been available to the Astrophysical Observatory of the Smithsonian Institution at Washington, D.C. In this paper are presented data for prismatic dispersion supplied by C. G. Abbot of that institution and recalculated for the normal or wave-length dispersion. AUTHOR.

***1996. Precision Radio Instrument for Transmitting Measurements of U.V. Intensities from Unmanned Balloons to a Ground Station. R. Stair.** *Bureau of Standards, J. of Research,* 22. *pp.* 295–300, *March,* 1939.—A new radio stratosphere u.v. meter which operates with a precision comparable with that of laboratory instruments is described. It consists of a photo-cell, a balanced amplifier, a relaxation oscillator, and a transmitter. The calibration of the instrument is automatically determined and broadcast to the receiving station each time an altitude signal is given.

The instrument, with accessories, including sufficient batteries to operate for about 4 hr., weighs about 5 lb. It operates on a frequency of approximately 50 Mc./sec. and has sufficient power to insure good reception for distances from the receiving station up to 100 miles. AUTHOR.

1997. Instantaneous Determination of Height in a Radio-Sounding. J. Lugeon. *Comptes Rendus*, 208. *pp*. 591–593, *Feb*. 20, 1939.—Graphical methods are suggested for determining the heights in a radio-sounding with an accuracy comparable with the instrumental data. In the first the variation of altitude in dynamic metres is plotted against the pressure, thus obtaining a system of t_v isolines (*i.e.*, lines of constant virtual temperature). On the system the sounding is plotted and from it the integrated height can be obtained at once using a planimeter. In place of Cartesian coordinates a system of polar coordinates may be used with the argument in millibars, the radius vector expressing the variation in altitude and the system of t_v isolines as circular arcs concentric with the origin. Diagrams of both systems are given, and the method of applying them indicated. A. E. M. G.

1998. Red CN Bands in Spectrum of Night Sky. G. Déjardin. *Comptes Rendus*, 208. *pp*. 751–753, *March* 6, 1939.—After referring to the known spectra of the night sky above 5000 Å, the author proceeds to discuss the results of observations made on a luminous discharge in N_2 in the presence of $NaClO_3$. The principal maxima in the region between 5000 and 6600 Å are given. Comparison between these and the known relatively intense radiations of the night sky led to a systematic search in the spectra of the night sky for the presence of the red bands of CN. The results of this comparison are given in tabular form. While the observations do not establish definitely the presence of red CN bands in the light of the upper atmosphere, yet, in the author's opinion, the hypothesis allows a fuller interpretation of the observations relative to the region of long waves in the spectrum. A. E. M. G.

1999. Colour Variations of Night Sky. R. Grandmontagne. *Comptes Rendus*, 208. *pp*. 754–755, *March* 6, 1939.—This note which is a continuation of previous work [see Abstract 4038 (1938)] deals with the composition of the red light of the night sky, and shows that it is not a fixed quantity. Two particular regions, 6800–7250 Å and 5850–6800 Å, are investigated, these regions being isolated with the aid of filters. In order to obtain an indication of the composition, comparisons are made between the intensities found for these regions and that for the region 5850–9000 Å transmitted by a third filter. A study of the 5850–6800 Å region in 1937–1938 is shown diagrammatically. This shows feeble emission at the beginning of the red from March to August. This result taken with observations on the variation of the 6300 Å line in summer, appears to show that this ray plays a considerable part in the total emission in this particular region of the night-sky spectrum. A. E. M. G.

2000. Origin of Colour of Auroræ of Type B. R. Bernard. *Comptes Rendus*, 208. *pp*. 824–826, *March* 10, 1939.—There are three types of auroræ, the ordinary type, type A and type B, and these can be distinguished by their respective colours. In type B, the lower edge is tinged with red. Several investigations, among them one by Harang [see Abstract 4106 (1936)], have been undertaken to determine the cause of the colour in this type. The present note considers the results of observations carried out at Tromsö during the winter 1937–38. All spectra show that for type B auroræ the bands in the yellow-red region are well marked, the more strongly coloured auroræ showing the more intense bands. The intensities are given in tabular form. The results of the author's investigation therefore do not appear to support Harang's conclusions. The origin of the radiations causing the red colour will be discussed in a later publication.

A. E. M. G.

***2001. Dew-Point Hygrometer for Use at Low Temperatures. C. A. Winkler.** *Canad. J. of Research,* 17. *Sect. D. pp.* 35–38, *Feb.,* 1939. —An apparatus is described in which provision for slow cooling of a metal mirror by circulating over it liquid from a vessel in a thermoregulated bath, and the use of multiple thermocouple elements contained in the mirror, enable the dew-point temperature to be gradually approached and accurately determined. Precise measurements of relative humidity at low temperatures, where the moisture content of the air is small, are therefore possible. A precision of ± 0·5% relative humidity was readily attained at temperatures down to − 15° C. AUTHOR.

2002. Meteorology for Aviators. R. C. Sutcliffe. *Air Ministry Publications, M.O.* 432 (*A.P.* 1699). [274 *pp.*], 1939.

See also Abstract 2162.

SEISMOLOGY.

2003. Propagation of Elastic Waves over the Surface of a Spherical Body. Y. Nomura. *Tohoku Univ., Sci. Reports,* 27. *pp.* 221–254, *Jan.,* 1939. *In English.*—The theory is studied of the propagation of vibrations over the surface of an isotropic elastic sphere of large radius, without taking into consideration heterogeneity and gravity. Three kinds of sources of disturbance which admit of simple interpretations are assumed. First a dilatational point source, secondly a distortional point source whose displacement has no azimuthal component, and thirdly a distortional point source whose displacement has an azimuthal component only. In each case it is first supposed that the disturbance is a simple-harmonic function of time having a complex frequency, and then the case is considered of a function giving an abrupt rise followed by a damped periodic fall and so resembling in a general way an explosion. The complete expressions were first found for the displacement at the surface in a series of spherical harmonics and then transformed the series into contour integrals. Assuming the point source to lie near the surface and taking only the terms involving the smallest power of the reciprocal of the radius, the representation of these integrals was obtained as the sum of the residues of all enclosed poles, and the expressions for the component waves spreading out from the source and travelling round the sphere in either direction were successfully deduced. The expressions for the waves coming directly from the source include the well-known solutions of similar problems, but for a plane boundary. AUTHOR.

2004. Descriptive Catalogue of Earthquakes of Pacific Coast, U.S.A., 1769 to 1928. S. D. Townley and M. W. Allen. *Seismological Soc. of America, Bull.* 29. [297 *pp.*], *Jan.,* 1939.

2005. Epicentres of Earthquakes, 1913-1932. E. F. Bellamy. *Nature,* 143. *pp.* 504–506, *March* 25, 1939.—The 2865 epicentres of the 7940 shocks recorded during the period 1913–32 are plotted showing the greatest density in the Mediterranean, on the boundaries of the Pacific, and down the central line of the Atlantic. The 350 deep-focus and 30 shallow-focus earthquakes are separately plotted, showing them to have occurred mainly along the western Pacific, and to a less extent in western S. America. C. A. S.

✱2006. Vertical Seismograph with Characteristic Period of 20 Sec. G. Pannocchia. *Ricerca Scientifica*, 10. *pp*. 119–123, *March*, **1939.**—A description is given of a new type of seismograph with a period much longer than that of the seismographs actually in use. The instrument is based on the principle of the clinograph with two important innovations: an electromagnetic system of registration, and an arrangement for making the instrument astatic. J. J. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2007. Electric Charges in the Atmosphere. E. Medi. *Ricerca Scientifica*, 10. *pp*. 124–129, *March*, 1939.—A method is described by means of which it is possible to determine, with simple graphical constructions, the position of an electric punctiform charge present in the atmosphere, through ascertaining by observations at four stations on the ground the electric field produced by the charge. J. J. S.

2008. E-Region of Ionosphere. E. O. Hulbert. *Phys. Rev.* 55. *pp*. 639–645, *April* 1, 1939.—Comparison of E-region observations from 1930 to 1938 of ionosphere stations scattered over the earth with the theory of ionisation caused by solar radiation absorbed exponentially in a relatively quiet terrestrial atmosphere yielded the conclusions: (1) the diurnal variation of y_m, the maximum-with-height value of the equivalent electron density, during daylight is in close accord with the theory with the recombination coefficient α proportional to y_m^2 and equal to 2×10^{-8}, or perhaps greater; (2) y_m at night was not in accord with the theory, but the data do not preclude a night value of $\alpha = 2 \times 10^{-8}$ or greater provided suitable hypotheses are added to the theory; (3) the morning increase in y_m was observed at Washington near midsummer to begin about 35 min. before ground sunrise, whereas the theory put it about 20 min.; (4) the seasonal variation of noon y_m agrees with the theory at stations in latitudes from 12° S. to 80° N.; (5) at any season noon y_m falls off with latitude more rapidly than the theoretical expectation. A relation between noon y_m and sunspots is given. [See following Abstract.] AUTHOR.

2009. E-Region of Ionosphere during Total Solar Eclipse of Oct. 1, 1940. E. O. Hulbert. *Phys. Rev.* 55. *pp*. 646–647, *April* 1, 1939. —It is pointed out that ionospheric observations during the total solar eclipse of Oct. 1, 1940, visible in northern Brazil, may provide data for an exacting test of the theory of solar radiation origin of the E-region and may yield a precise value of the ionic recombination coefficient α that occurs in the theory. To this end E-region ionisation curves are worked out for various assumed values of α during the eclipse. [See preceding Abstract.] AUTHOR.

2010. Ephemeral Variations of Earth's Magnetism. L. V. Berkner and A. G. McNish. *Cooperation in Research, Publ. No.* 501. *pp*. 223–247, 1938.—The problem of accounting for the variations resolves itself into determining the location, form and origin of the electric currents which flow about the earth. The paper discusses researches on these points and their interpretations. Balfour Stewart's theory assumes the existence of atmospheric tides, the motion of which across the earth's lines of force sets up e.m.f.s as in a dynamo. To ascertain the intensity of electrification of the upper air, equipment was set up in the Department of Terrestrial Magnetism to measure and record continuously the virtual height and electrification of the regions of the ionosphere. One record shows that, simultaneously with the appearance of an intense chromospheric eruption, h.f. radio signals cease to be reflected from the ionosphere and changes take place in the earth's magnetic field. A series of records made by automatic apparatus demonstrates that the solar eruptions affect mainly and almost solely the regions of the ionosphere below 90 km. It is strongly indicated that the currents which produce diurnal variations flow in the lower region of the ionosphere as theory requires. The auroral zones are regions of concentrated current flow round the poles. During magnetic storms, several million amperes may flow in paths 600 or 700 km. wide at a height of about 100 km. and about 23° from the geomagnetic poles. Important changes occur in the structure of the ionosphere during a magnetic storm, but a comprehensive picture of what takes place is not yet possible. A close relation exists between magnetic disturbance and radio transmission but the mechanism of the effect is not yet clear. Times favourable or otherwise for radio transmission can now be forecast with a fair degree of reliability. Of the two main regions of ionisation in the atmosphere, the upper divides into two (F_1 and F_2) when the sun is high. The heights and electronic densities of these layers undergo diurnal variation. The changes in the lower layers indicate that ultraviolet rays are responsible for the effects. From the theory of Lorentz it results that radio waves passing through an ionised medium in the presence of a magnetic field suffer great retardation if the frequency of the waves bears a certain relation to the magnetic field. Recent experiments by the Department have verified this conclusion. G. E. A.

***2011. Primary Standard for Measuring Earth's Magnetic Vector. Part I. Theory. E. A. Johnson.** *Terr. Mag.* **44.** *pp.* **29–42,** *March,* **1939.**—The theory of a new primary standard for measuring any component of the earth's magnetic field is developed. The magnetometer consists of a Helmholtz-Gaugain coil which provides a standard field opposed to that component of the earth's magnetic field which is to be measured, and a rotating coil used as a null detector. The voltage generated in the rotating coil is detected by an a.c. amplifier. The constant of the Helmholtz-Gaugain coil is computed from the formulæ developed by C. Snow from the mutual inductance between two concentric cylinders. Corrections are computed for the fact that the Helmholtz-Gaugain coils are helices, for the axial components of current, for the effect of the lead-in wires, and for non-uniformities in winding. The finite size of the detector is not a limitation on the accuracy since it is taken into account in the computation. Consequently, the accuracy of the coil-constant of the new standard depends only upon constructional accuracy. Inhomogeneity in the field of the Helmholtz-Gaugain coil necessitates the use of small correction-terms to the voltage of fundamental frequency generated in the detector and produces odd harmonics of the fundamental frequency in the detector. The errors in orientating the Helmholtz-Gaugain coil are also examined. The limiting sensitivity of the detector is calculated from the thermal agitation of electricity in the coil of the detector. AUTHOR.

See also Abstracts **2162, 2262.**

RADIOACTIVITY.

2012. Gaseous Radioelement Formed by Bombardment of U by Neutrons. P. Savitch. *Comptes Rendus*, 208. *pp*. 646–647, *Feb*. 27, 1939.—Uranium oxide, spread on the internal surface of a vacuous glass globe, across which an electric current was passed between electrodes of Al foil and W wire, was exposed to neutrons from Rn + Be (700 mC). The activity of the Al after irradiation in such circumstances is greater than when U is absent, the period of the activity being about 20 min. That the cause of this is a radioactive gas is proved by its condensation on carbon cooled by liquid air and placed in a side tube so that it is out of a direct line from the uranium. Its chemical nature has not yet been determined. C. A. S.

2013. Trajectories of Products of Explosion of U Nuclei. F. Joliot. *Comptes Rendus*, 208. *pp*. 647–649, *Feb*. 27, 1939.—The curve of decrease of activity of the deposit on the bakelite cylinder [see Abstract 1584 (1939)] closely resembles that of UO_2 directly irradiated by neutrons. Photographs of the trajectories of tracks given by the former in a Wilson chamber show, besides tracks attributable to α-particles, a track indicating approximately quadruple ionising power, and implying a particle of mass about 100 resulting from explosion of a U nucleus. The relative numbers of tracks and rate of production are of the right order. C. A. S.

2014. Explosive Rupture of Nuclei of U and Th by Neutrons. F. Joliot. *J. de Physique et le Radium*, 10. *pp*. 159–160, *March*, 1939.—A connected summary is given of the evidence that has replaced the view that bombardment of U and Th with neutrons results in the production of trans-uranian elements by the conclusion that it results in the splitting of the atoms into two of lower atomic weight. [See Abstract 1584 (1939).] C. A. S.

2015. Disintegration and Partition of U Nuclei by Neutrons. J. Thibaud and A. Moussa. *Comptes Rendus*, 208. *pp*. 652–654, *Feb*. 27, 1939.—Uranium oxide after long irradiation with neutrons from Rn + Be was dissolved in H_2SO_4. NH_4Br and $KMnO_4$ were then added, and all the Br distilled off and converted into AgBr. This was found to be radioactive, indicating that the Br from the NH_4Br was now accompanied by radioactive Br. The product showed 3 periods: the first short, the second 1·5 hr., and the third about 20 hr. It is suggested that the U first split into ${}^{88}_{35}\mathrm{Br}$ and ${}^{131}_{57}\mathrm{La}$, of which the Br passes with successive β-ray emissions into Kr and Rb and finally ${}^{88}_{38}\mathrm{Sr}$; and the La into Ce, Pr, Nd, element 61, Sm and finally ${}^{151}_{63}\mathrm{Eu}$. The amounts of energy liberated are shown to be of the right order. [See Abstract 1584 (1939) and following Abstract.] C. A. S.

2016. Rupture of U Nuclei by Neutrons and Liberation of Resultant Energy. J. Thibaud and A. Moussa. *Comptes Rendus*, 208. *pp*. 744–746, *March* 6, 1939.—Further evidence [see preceding Abstract] based on the distribution of energies, range of resultant nuclei in Al, effective cross-section for rupture of U, and effects of slow neutrons as shown by change (or absence thereof) in effect when the irradiating neutrons are passed through screens of Cd and B before falling on the U, is adduced in support of the rupture of the U nucleus into two strongly ionising nuclei of atomic weights approximately 90 and 150. Similarly irradiated with neutrons in presence of paraffin, if Bi, Pb, Tl, Ta, W or Mo undergo rupture, the probability of their doing so is not more than 1/250th of that for U. Further chemical evidence that one of the elements resulting from rupture of U is Br is described. C. A. S.

2017. Emission of Neutrons on Rupture of U Nucleus. Possible Chain Reaction. C. Haenny and A. Rosenberg. *Comptes Rendus,* 208. *pp.* 898–900, *March* 20, 1939.—As the neutron-proton ratio in an element increases with the atomic number, the result of splitting the U nucleus into two of lower atomic number must be the production of nuclei in which this ratio is excessive for the number. This excess of neutrons may be emitted as such, or got rid of by emission of γ-rays and consequent reduction of a neutron to a proton. If the former the effect of neutrons on a mass of U might be progressive and become catastrophic. Some evidence in support of this has been obtained by examining the result of surrounding a source of neutrons with a large amount of U_3O_8 by means of a hexane ionisation chamber [see Abstract 1965 (1938)], when an increase of 20% was shown in the effect produced by neutrons. [See following Abstract.] C. A. S.

2018. Energy of Neutrons Liberated by Division of U Nucleus. M. Dodé, H. v. Halban, Jr., F. Joliot and L. Kowarski. *Comptes Rendus,* 208. *pp.* 995–997, *March* 27, 1939.—300 mg. Ra in a block of Be 6 × 6 × 2 cm. irradiated a surrounding layer of uranyl nitrate of average thickness 10 gm./cm.^{2}, the whole being immersed in a vessel containing 8l. of CS_2 in which 200 mg. of P had been dissolved. After 6 days irradiation the P was separated and its activity examined; this showed that ^{32}P had been formed for which neutrons of energy $> 2 \times 10^6$ eV are necessary. When the experiment was repeated omitting the uranium only 1/6th of the amount of ^{32}P was obtained. This difference must be due to neutrons produced in the U, and distinct from those incident thereon [see preceding Abstract]. As, however, the total energy can increase without increase in the number of neutrons neither experiment is decisive as to the occurrence of a chain reaction. C. A. S.

2019. Transmutation of Light Nuclei and Their Theoretical Interpretation. T. Kahan. *Comptes Rendus,* 208. *pp.* 649–651, *Feb* 27, 1939.—A discussion as to what happens when a light nucleus is struck by a helion, proton, etc. It is shown that comparing the nucleus to a drop of incompressible fluid leads to no satisfactory result. It is suggested that the problem should be dealt with in several phases, considering first the effects of resonance, and then treating it as one of collision between the incident particle and one of the particles constituting the nucleus, then between it and 2 such particles, then with 3 and so on. Though the method would involve long and intricate calculations it should be possible in the case of light nuclei consisting of but few nuclear particles. C. A. S.

2020. Rupture of Elements Lighter than U by Neutron Bombardment. C. Magnan. *Comptes Rendus,* 208. *pp.* 742–744, *March* 6, 1939.—Repetition of Joliot's experiment of bombarding U with neutrons [see Abstract 1584 (1939)] gave products of periods 45 sec., 18 min. and 55 min., while Au similarly bombarded gave products of feebler activities of periods 22 sec. and about 2 min. Using de Broglie and Leprince-Ringuet's ionisation chamber and amplifier nuclei of energies between 49 and 98 × 10^6 eV were detected. With a still more powerful arrangement the effect with Au was confirmed, and similar but more feeble effects were obtained with W and Ti, but definitely none with Bi, Ta, Te, Cd, Ag, Pd, Mo, Zr, and Sr. C. A. S.

2021. Idea of Surface Tension in Nuclear Physics. J. Solomon. *Comptes Rendus*, 208. *pp.* 896–898, *March* 20, 1939.—The application of the idea of surface tension [see Abstracts 2676 (1934) and 4427 (1935)] to illustrate the rupture of the nucleus by neutron impact [see Abstract 1586 (1939)] is discussed, the nucleus, the energy of the particles at the surface of which differs from that of those in its interior, being likened to a droplet of liquid. The energy conditions necessary to produce rupture are shown to be of the right order. C. A. S.

2022. β-Ray Spectrum of N^{13}. S. Kikuchi, Y. Watase, J. Itoh, E. Takeda and S. Yamaguchi. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 52–58, *Feb.*, 1939. *In English.*—Describes the results of experiments investigating the energy spectrum of disintegration positive electrons of N^{13} by means of the magnetic spectrometer, the N^{13} being produced by bombarding C with high energy deuterons from a cyclotron. Fair agreement with theory is obtained. A. H.

2023. Radioactivity of Li^8. C. Kittel. *Phys. Rev.* 55. *pp.* 515–519, *March* 15, 1939.—The continuous distribution of α-particles observed in conjunction with the β-decay of Li^8 is examined theoretically from the Fermi theory of β-decay. It has previously been noted that the Konopinski-Uhlenbeck theory does not give the distribution correctly. An approximate form of the Fermi theory suffices to account for the general form of the distribution. Calculations are presented for $L = 0$ and $L = 2$, with several values of the nuclear radius. An abnormally small value of Fermi's constant g is found for the β-decay process, which classes the process as improbable. The consequences of a stable ground state for Be^8 are discussed. AUTHOR.

2024. Radiations from Au^{198}, Eu^{152}, Ag^{106}, Cu^{64} and N^{13}. J. R. Richardson. *Phys. Rev.* 55. *pp.* 609–614, *April* 1, 1939.—By use of a 12-in. H_2-filled cloud chamber situated in a magnetic field, investigation has been made of the γ-radiation from Au^{198} and Eu^{152}. Observations on the 2·7-day period of Au^{198} indicate three lines with energies 70, 280 and 440 kV, and relative intensities 0·15, 1·0 and 1·2. The β-spectrum has an inspection upper limit of 0·83 eMV and the distribution shows that the 440-kV γ-radiation is internally converted with a coefficient of 0·1. Thus the 70-kV radiation is probably entirely K radiation emitted after internal conversion. The Eu^{152} γ-distribution shows three main groups of 40 kV, 0·3 and 0·9 eMV. The 40-kV radiation is ascribed to the K radiation of Sm emitted as a consequence of the orbital electron capture process in Eu^{152}. Evidence is also found for the K-electron capture process in the 8-day isomer of Ag^{106}. In fact the electron spectrum probably consists of secondary electrons from the γ-radiation following the capture process. The distribution of electrons ejected from a lead radiator by a thin source of N^{13} is compared with that from a Cu^{64} source under the same geometrical conditions. The data seem to indicate the presence of a γ-ray of 280 kV from N^{13} with the relative probability of roughly 0·4 quanta per positron. The necessity for radiators of different materials for complete investigation of a γ-ray spectrum is emphasised. [See following Abstract.] AUTHOR.

2025. γ-Radiation from $^{198}_{79}$Au. G. J. Sizoo and C. Eijkman. *Physica*, 6. *pp.* 332–336, *April*, 1939. *In English.*—The absorption of the γ-radiation of $^{198}_{79}$Au is measured in lead up to an absorber thickness of 3·5 cm. In addition to the three components already found by Richardson

[*Phys. Rev.* 53. *p.* 942, *June* 1, 1938], a fourth component is observed, with an energy of about 2·5 eMV and an intensity of about 0·02 quanta per disintegration. The possibility that this radiation is connected with the transition of ${}^{198}_{79}$Au to ${}^{198}_{78}$Pt by electron capture, is mentioned. [See preceding Abstract.] AUTHORS.

2026. Neutron Excitation Functions for ${}^{27}_{13}$Al and ${}^{10}_{5}$B. A. Szalay. *Zeits. f. Physik,* 112. 1–2. *pp.* 29–44, 1939.—The excitation curves for neutron emission on bombardment of Al^{27} and B^{10} with α-particles from Po have been investigated up to an α-particle energy of 5·3 eMV, with an apparatus with very high resolving power, by studying the artificial radioactivity produced. The absolute yields from the transitions were quantitatively estimated. For the intermediate nucleus ${}^{31}_{15}$P four resonance energies very close together were found; alternate pairs of these are present or absent in the case of proton emission. The question of the conservation of angular momenta was discussed for these transformations. A selection rule was determined for these transitions of the intermediate nucleus ${}^{31}_{15}$P. For neutron emission from B^{10}, a series of resonance energies was found. The integrated yield for the B^{11} transformations was calculated. The properties found for the excited states of the intermediate nuclei are in good agreement with Bohr's theory. G. O. B.

2027. Disintegration of Separated Isotopes of Boron under Proton and Deuteron Bombardment. C. L. Smith and E. B. M. Murrell. *Cambridge Phil. Soc., Proc.* 35. *pp.* 298–303, *April,* 1939.—The disintegration of the separated isotopes of B, under proton and deuteron bombardment, has been investigated, and it is shown that the groups of disintegration particles previously discovered had been attributed to the transmutation of the correct isotopes. In addition, experimental evidence has been obtained for a previously unknown excitation level of ^{8}Be at about $7·5 \times 10^6$ eV above the ground state. AUTHORS.

2028. Production of ^{8}Li by Bombardment of Boron with Neutrons. A. M. Lawrance. *Cambridge Phil. Soc., Proc.* 35. *pp.* 304–308, *April,* 1939.—The decay period of the α-activity produced when B is bombarded with neutrons from a (Li + D) source has been measured, and found to agree with the known decay period of ^{8}Li. It has been shown that no activity is produced when (Be + D) neutrons (maximum energy $4·5 \times 10^6$ eV) are used. The results are explained by postulating the formation of radioactive ^{8}Li according to the process ${}^{11}B + {}^{1}n \rightarrow {}^{8}Li + {}^{4}He$. A short investigation of the number-range distribution for the α-particles emitted by ^{8}Li indicated maximum distribution at range *ca.* 6 mm. AUTHOR.

2029. Wave-Length Dependence of Radioactive Se Isotopes Nuclear Photo-Effect. W. Bothe and W. Gentner. *Zeits. f. Physik,* 112. 1–2. *pp.* 45–64, 1939.—An electrostatic generator with canal-ray tube for 1000 kV is described. With the γ-radiation from $B^{11}(p, \gamma)C^{12}$ nuclear photo-effects were observed in a series of elements and their relative yields determined. Disturbances through neutrons were prevented. The γ-absorption spectra of the nuclei are continuous and increase generally with rise of *hν*. The two isotopes of Se of half-value times 17 min. and 57 min. arising from nuclear photo-effect have masses < 82 [see Abstract 3801 (1937)]. J. J. S.

2030. Element 43. E. Segrè. *Nature,* 143. *pp.* 460–461, *March* 18, 1939.—Five isotopes of element 43 have been obtained, in a total quantity of the order of 10^{-10} gm., by bombarding Mo with deuterons or neutrons in the Berkeley cyclotron. This element is specially identifiable by the

Kα line of its X-ray spectrum, the internal conversion of the γ-rays emitted when one of the isotopes decays into another ejecting the K electron which emits the line, which can be photographed in the bent crystal spectrograph. C. A. S.

2031. Disintegration of Polonium. M. Ferber. *J. de Physique et le Radium*, 10. *pp*. 134–142, *March*, 1939.—This paper continues work previously carried out showing deviations between experimental and theoretical ($\beta e^{-\beta x}$) distributions of time intervals between successive emissions of α-particles from Po [see Abstract 4062 (1938)]. Using an extremely weak Po source at the centre of a spherical ionisation chamber and counting particles emitted in *all* directions, deviations previously obtained with a strong source and small solid angle are accentuated. 2160 intervals are arranged in order of magnitude, and the resultant series is divided into 10 equal sub-series, a, b, c, . . . k. The distributions of the 10 sub-series of intervals immediately following the intervals contained in a, b, c, . . . k show considerable deviations from the theoretical distribution ($1 - e^{-\beta x}$). These distributions can be represented by theoretical curves obtained by introducing the polynomials $L_n(x) = e^{\beta x}(d/dn)^n(e^{-\beta x}x^n)$. Results show that the intervals between consecutive emissions are not entirely independent ; average intervals are infrequently followed by short intervals, and either very long or very short intervals produce divergences from the theoretical distribution in the intervals immediately succeeding them. E. E. W.

2032. H_2-Br_2 Reaction under the Influence of α-Particles. E. F. Ogg. *J. Phys. Chem.* 43. *pp*. 399–406, *April*, 1939.—The temperature coefficient of the HBr reaction (synthesis) by α-particles has been studied between 40° and 192° C. The average value obtained per 10° C. interval was 1·07. As the temperature rises the temperature coefficient value keeps decreasing, owing to the increasing decomposition of the HBr formed thermally. Owing to the fact that the M/N values were not found to exceed 2, it was concluded that the purely ionic reaction did not proceed by the clustering mechanism postulated earlier. The M/N value for the decomposition of HBr by α-particles was found to be rather high compared to the M/N value for the synthesis, a value of approximately 3 being found. Evidence was found to indicate that the M/N yields obtained at room-temperature are proportional to the square root of the total radon decomposed. AUTHOR.

2033. Distribution of Intensity of Compton Scattering of γ-Rays. Z. Bay and Z. Szepesi. *Zeits. f. Physik*, 112. 1–2. *pp*. 20–28, 1939.—A new method for the investigation of the scattering of γ-rays is described. By a ring-shaped arrangement of the scattering material better angle relations were obtained. By the arrangement the distribution of intensity of the scattered rays from γ-rays of Ra filtered through 2·5 cm. Pb was measured. The measurements agree well with the values calculated from the Klein-Nishina formula. J. J. S.

2034. Nuclear Effect in the Scattering of γ-Rays. Z. Bay and G. Papp. *Zeits. f. Physik*, 112. 1–2. *pp*. 86–91, 1939.—An experimental determination is now recorded of the intensity distribution of Ra γ-rays scattered by lead foil. A comparison with data for Al indicated that the nuclear scattering by Pb for an angle interval of 90° is independent of the angle within the limits of statistical and experimental errors. A comparison between nuclear and Compton scattering showed that the experimental results could be brought into agreement with the calculations of Jaeger-Hulme and Klein-Nishina. H. H. Ho.

2035. Fluctuations in the Emission of γ-Rays. Part I. J. Gürtler. Part II. R. Fürth. *Ann. d. Physik,* 34. 6. *pp.* 561–584, *March,* 1939.—The single counts and coincidences of 2 G.-M.-counters exposed to a γ-ray source are registered, the fluctuations in the single counts are compared with theory and the variation of coincidences with the angle between the counters is discussed. A Ra-source of 0·6 mC. in a lead cylinder was used, the counters moving on a circle of 50 cm. radius round it. The single counts and coincidences were amplified in a set of 9 valves, with which a resolving time of 1/80 sec. for single counts and 1/200 sec. for coincidences was achieved. The amplified current pulses were recorded directly on a moving strip of starch-iodide paper. Several runs were taken with the counters in 4 different angular positions, 169 min. in all. The singles (per min.) were about 190 and 260 for the 2 counters, about 10% of it zero count. The fluctuations of the counts show a small deviation from the Poisson formula which disappears when a correction allowing for the finite resolving power of the set is applied. The number of coincidences (most of them accidental) was 5–6 per min., and showed an increase of about 20% for an angle of 20° over the count at 180°. The author claims that the higher count at small angles is due to real coincidences which are produced when a secondary quantum created by a Compton electron and the scattered primary quantum are causing the two counters to discharge simultaneously. L. E. F.

2036. Internal Conversion of γ- and X-Rays from RaD. E. Amaldi and F. Rasetti. *Ricerca Scientifica,* 10. *pp.* 111–114, *March,* 1939.—Using a Geiger counter in the form of a glass tube containing a wire spiral kathode, the internal conversion of γ- and X-rays from RaD is examined. Methyl iodide vapour at a pressure of 9 cm. of Hg filled the counter and produced satisfactory absorption of the radiations. The working voltage was 2700. Comparison with the radiation from K as a standard showed the efficiency of the counter to be about 40%. The radiation is observed to consist of at least two components and the internal conversion in the L-level amounts to more than 50%. [See following Abstract.] F. C. C.

2037. Radiation Emitted from Gd on Capture of Slow Neutrons. E. Amaldi and F. Rasetti. *Ricerca Scientifica,* 10. *pp.* 115–118, *March,* 1939.—With similar apparatus to that used to examine the internal conversion of radiation from RaD [see preceding Abstract], it is shown that Gd emits a soft electronic radiation on capture of slow neutrons. It is estimated that about one electron is emitted per neutron absorbed. An absorption curve of the radiation in Al indicates that it is homogeneous with energy about 70 ekV. By using a rotating source the half-life was shown to be less than 10^{-3} sec. Negative results followed an attempt to detect X-rays which would be produced if the electrons came from the extra-nuclear structure and it is therefore concluded that they are nuclear in origin. F. C. C.

2038. γ-Rays of Ionium. A. G. Ward. *Cambridge Phil. Soc., Proc.* 35. *pp.* 322–326, *April,* 1939.—The absorption of the harder γ-rays from ionium has been studied, the first, of energy 68 ± 1 ekV, by the method of bracketing, making use of the *K* absorption discontinuities of Ta and W; the second, of energy 190 ± 20 ekV, by analysis of the absorption curves. The intensity of these γ-rays is estimated to be 1 quantum in 10^{-3} disintegration for each γ-ray. AUTHOR.

***2039. Construction of Geiger-Müller Counters and their Use in Coincidence Experiments. S. C. Curran and V. Petržílka.** *Cambridge Phil. Soc., Proc.* 35. *pp.* 309–321, *April,* 1939.—The technique adopted in some experiments employing Geiger-Müller counters is described. The behaviour of a counter in which the extinction of the discharge is external is contrasted with behaviour of a counter in which extinction is internal and dependent on the addition to the gas of some organic vapour such as alcohol. It is shown that the internally extinguished type of counter may be used with a resistance of the order 50,000 ohms in series with it while still retaining all its useful features. Methods of construction of internally extinguished counters are described, particular attention being paid to the question of developing a thin-walled type suitable for experiments employing the method of coincidences. The effect of using different wall materials and gases is investigated with a view to finding those most suitable. The measurement of the quantum energy of hard γ-radiation by the method of coincidences is discussed and details of a reliable two-stage amplifying circuit with a resolving time T of 10^{-6} sec. are given. Various factors which may influence the value of T are noted. AUTHORS.

***2040. Mode of Operation of Spark Counters. R. Stuber.** *Helv. Phys. Acta,* 12. 2. *pp.* 109–146, 1939. *In German.*—The effect of form, size, material and nature of surface of electrodes on the occurrence of sparking was examined at potentials between 150 and 1000 V. At the lower limit the strong ionisation of α-particles only was effective and below a gas pressure of 20 tor. no counting occurred. The effective volume of the counting region varied with the nature of the ionising agents and was generally spherical and about $0{\cdot}1$ mm^3. It was shown by coincidence measurements that all β-particles entering this region were counted. The surge of potential following a spark was examined with an oscillograph and found to correspond to about 80% of the applied potential. A magnetic field produced no detectable result on the number of counts. The effects of changes in the parameters of the counting circuit was also examined. The working potential has to be raised continually as sparking proceeds and the theory of the apparatus is discussed in detail. F. C. C.

See also Abstracts 1857, 1860, 2046, 2050, 2057.

RADIATION.

COLORIMETRY.

2041. Colorimetric Principles and Conventions. P. Fleury. *Rev. d'Optique,* 17. *pp.* 337–349, *Oct.,* 1938.—A concise account of the main principles of trichromatic colorimetry. W. S. S.

EMISSION.

2042. Photon Equations and their Relation to the Equations of Dirac and Kemmer. M. A. Tonnelat. *Comptes Rendus,* 208. *pp.* 790–793, *March* 13, 1939.—Theoretical. A. J. M.

2043. Table and Graph for Black-Body Radiation Calculations. Z. Miduno. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 89–90, *Feb.*, 1939. *In English.*—Corrections to the original [see Abstract 1126 (1939)].

2044. Spectral Emissivity and Relation of True and Brightness Temperatures of Platinum. R. E. Stephens. *J.O.S.A.* 29. *pp.* 158–161, *April*, 1939.—Spectral emissivities of Pt for 660 $m\mu$ have been measured by using an optical pyrometer to compare the brightness of the surface of an incandescent tubular filament with that of a small hole through the wall of the tube. They have been used to compute true temperature as a function of brightness temperature, for the range 1200° to 1900° K. true temperature. The emissivity was found to vary linearly with temperature, from 0·283 at 1200° K. to 0·295 at 1900° K. The brightness of an incandescent Pt surface was found to vary with angle of emission rising to a maximum 1·24 times the normal brightness at an emission angle of 80° and decreasing thereafter. AUTHOR.

2045. Mesotrons in Cosmic Radiation. W. Kolhörster and I. Matthes. *Phys. Zeits.* 40. *pp.* 142–143, *Feb.* 15, 1939.—The variation of the cosmic-ray intensity with atmospheric pressure was determined, using a double-coincidence counting assembly; the apparatus was covered with a wooden absorber whose thickness was varied, as the atmospheric pressure varied, so that the total mass of absorber (*i.e.*, atmosphere + wood) traversed by the radiation remained constant. It is found that the pressure-effect remains at approximately the value found under ordinary conditions for the hard component. It follows that the absorption of the radiation by the atmosphere is a function of the actual path length, and not merely of the total mass of air traversed. This is to be expected on the hypothesis that the hard component consists of mesotrons, and from the results the value 4×10^{-7} sec. is calculated for the mean life period. D. H. F.

2046. Neutrons in Cosmic Radiation. H. v. Halban, Jr., L. Kowarski and M. Magat. *Comptes Rendus*, 208. *pp.* 572–574, *Feb.* 20, 1939.—Cosmic-ray neutrons were measured by determining the amount of the radio-element $^{88}_{35}$Br (period 4·5 hours) produced in ethyl bromide in the absence of any source of neutrons. The amount produced indicates a lower limit of 10 neutrons incident per cm^2. per min. in Paris. At an altitude of 9500 m. a lower limit of about 1000 is found. It is pointed out that the ratio of these figures does not necessarily accord with the ratio of the actual neutron intensities at those levels. D. H. F.

2047. Penumbra at Geomagnetic Latitude 20° and Energy Spectrum of Primary Cosmic Radiation. R. A. Hutner. *Phys. Rev.* 55. *pp.* 614–620, *April* 1, 1939.—The method of obtaining the penumbra presented in a previous paper [see Abstract 675 (1939)] is applied to the following energies: $r = 0{\cdot}385, 0{\cdot}400, 0{\cdot}425, 0{\cdot}450$ and $0{\cdot}500$ Störmer at a geomagnetic latitude of 20°. Two graphs showing the variation of the penumbra with the energy are derived from the (γ_1, η) diagrams of these energies: one at a constant zenith angle of 60°, and the other along the east-west plane. If the number of primaries is assumed to vary inversely as the 2·8 power of their energy, the contribution of the penumbra to the directional intensity at a zenith angle of 60° is calculated, and is shown to be far from negligible. The calculated intensities are quite sensitive to the energy distribution used, and this suggests a possible method for determining the energy spectrum of primary cosmic rays. AUTHOR.

2048. Decay of Penetrating Cosmic Rays. E. M. Bruins. *K. Akad. Amsterdam, Proc.* 42. 1. *pp.* 54–60, 1939.—The calculations by Euler and Heisenberg [see Abstract 4474 (1938)] of the energy spectrum of the mesotrons in the atmosphere are modified; when applied to the intensity measurements of Clay *et al* [see Abstract 4475 (1938)] for depths between 0 and 50 m. of water they lead to a value of $1\cdot 5 \times 10^{-6}$ sec. for the mean life of the mesotron. D. H. F.

2049. Total Intensity of Cosmic Radiation in the Atmosphere. R. Auer. *Zeits. f. Physik*, 111. 9–10. *pp*. 559–587, 1939.—General consideration is given to the question of the accuracy of ionisation measurements obtained from balloon ascents, as affected by the accuracy of calibration and the dependence between gas-pressure and ionisation. It is concluded that for altitudes > 8 km. these factors limit the precision of the measurements to 3%, and that the total uncertainty in absolute determinations amounts to 6%. The hitherto unpublished observations from 7 ascents made between 1934 and 1937, at lat. 48°–49° N., long. 9°–11° E., are given; the individual curves differ from one another by less than 3%, and the mean curve is considered to be of high accuracy. The latitude effect at high altitudes is studied, from a consideration of the available data. D. H. F.

2050. Radioactive Phenomena of the Second Order. G. Reboul. *J. de Physique et le Radium*, 10. *pp*. 151–158, *March*, 1939.—The experiments which the author interpreted as establishing the emission of a soft ionising radiation by charged insulators, are discussed again in connection with criticisms brought forward by Eichenberger in 1936. While it is conceded that the action on photographic plates may be partly due to chemical processes, the alternative interpretation of the effects in an ionisation chamber in terms of residual polarisation, proposed by Eichenberger, is held to be incompatible with the actual conditions of the experiments which more recently have been repeated and elaborated by Perrier [see Abstracts 4443 (1936) and 1974 (1938)]. L. E. F.

See also Abstracts 2055, 2114, 2116, and

1116B. Particles of Cosmic Rays. K. K. Darrow.
1172B. Operating Characteristics of Incandescent Lamps. E. W. Beggs.
1175B. High Efficiency Mercury and Sodium Vapour Lamps. L. J. Buttolph.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2051. Equilibrium Potentials of Luminescent Materials under Electron Bombardment. H. Bey. *Phys. Zeits*. 39. *pp*. 605–611, *Aug*. 15, 1938.—An electrically insulated screen of luminescent material exposed to an electron beam takes, for not too high anode potentials, a positive charge, and its potential is equal to that of the anode. As the anode voltage is increased above a certain level the screen potential is less than the anode potential. Curves are shown correlating the luminosity and the screen potential and it is seen that the point where the anode and screen potential cease to be equal also corresponds to an anomaly in the luminosity curve. The efficiency is higher for a metallic screen which is connected to the anode. In the case of an insulated screen the balance of charge is kept by secondary electron emission. R. P.

2052. Influence of Electric Field on Electrophotoluminescence. G. Destriau and Loudette. *Comptes Rendus*, 208. *pp*. 891–893, *March* 20, 1939.—A continuation of the work described earlier [see Abstract 679 (1939)] where luminescence was excited simply by the action of a variable electric field. A slight deformation of some of the bands is observed as compared with other methods of excitation. A. H.

2053. Luminescence and Absorption of ZnS-MnS Mixed Crystals. F. A. Kröger. *Physica*, 6. *pp*. 369–379, *April*, 1939. *In English*.—ZnS phosphors activated with Mn are mixed crystals of ZnS with MnS. The luminescence spectrum of ZnS-MnS phosphors consists of two bands with maxima at 5850 and 6200 Å approximately. The emission of phosphors activated with Mn is due to two electron transitions in the Mn^{++} ion, which also occur in absorption. Mixed crystals of ZnS and MnS show absorption in three parts of the spectrum. Two are practically identical with the bands found for pure ZnS, and the third is a system of bands due to electron transitions in the Mn^{++} ion. Irradiation of the phosphor in the three absorption ranges always produces luminescence in the characteristic Mn bands. Irradiation in the first two absorption ranges gives rise to phosphorescence and fluorescence, whilst irradiation in the bands characteristic of Mn produces only fluorescence. The dependence of the intensity of luminescence on the temperature, and quantity of Mn used to activate the phosphor was determined. A. J. M.

2054. Chemiluminescence of Dimethyl-Diacridylium-Nitrate. B. Tamamushi and H. Akiyama. *Faraday Soc., Trans*. 35. *pp*. 491–494, *April*, 1939.—The sensitiveness to heat and to molecular oxygen of the luminescent reaction of dimethyl-diacridylium-nitrate in alkaline solution is demonstrated and the behaviour of the reaction towards catalysts is indicated. A reaction mechanism, which includes the formation of a free biradical, is suggested for the chemiluminescence caused by molecular O_2 at higher temperatures. AUTHORS.

See also Abstract

1176B. Basis for High Efficiency in Fluorescent Lamps. R. N. Thayes and B. T. Barnes.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2055. Dipole Nature of Elementary Light Centres. P. Selényi. *Zeits. f. Physik*, 111. 11–12. *p*. 791, 1939.—In a previous paper [see Abstract 1994 (1938)] experiments were reported on the emission of radiation of dipole character from the light centres in a fluorescing solution. One statement in the paper was ambiguous and may give the impression that the centres were excited with polarised light; it is now pointed out that excitation was with normal unpolarised light, the emission being observed through a polarising filter. J. E. K.

2056. Extended Diffraction. J. Savornin. *Ann. de Physique*, 11. *pp*. 129–255, *Feb*., 1939.—In this paper are gathered together the results of previous work on the subject of diffraction at a straight edge [see Abstract 4473 (1937)]. After an historical introduction, there is a large section devoted to experimental work and results. The remainder of the paper examines various theories in the light of the experimental results. F. S.

See also Abstracts 1891, 2033, 2082.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2057. Radioactive Carbon in Study of Photosynthesis. S. Ruben, W. Z. Hassid and M. D. Kamen. *Am. Chem. Soc., J*. 61. *pp*. 661–663, *March*, 1939.—Using short-lived radioactive C^{11} as an indicator, the assimilation of $C^{*}O_2$ by barley has been studied. $C^{*}O_2$ fixation has been observed both in the absence and presence of light. Leaves kept in complete darkness as well as illuminated leaves formed radioactive carbohydrates. When, however, leaves were placed in the dark for 2·5 to 3 hr. prior to the administration of C^*O_2 the formation in the absence of light of radioactive carbohydrates could not be detected. The chlorophyll contained radioactivity after exposure to C^*O_2 in the light but not after exposure in the dark. The bulk of the radioactive material found in the plant is water soluble and is not carbohydrate, carbonate, keto acids, or pigments. These results seem to indicate that the cell contains substances, either directly involved in photosynthesis or in respiration, which react with C^*O_2 reversibly in a non-photochemical process. A more complete report of these and other experiments now in progress will be reported later. AUTHORS.

2058. Mercury-Sensitised Decomposition in Light of 1849 Å. Part I. CO_2. J. E. Cline and G. S. Forbes. *Am. Chem. Soc., J.* 61. *pp.* 716–718, *March,* 1939.—Purified CO_2 freed from H_2O at − 78° and saturated with Hg vapour is unaffected by resonance radiation of 2537 Å provided that radiation of 1849 Å is entirely excluded by suitable filters. It is rapidly decomposed, however, when radiation of 1849 Å is admitted. The quantum yield of the decomposition sensitised at 1849 Å is at least as great as 0·8 and very possibly could become unity if certain suggested corrections could be applied. Assuming that Hg vapour is not at all excited by the radiation of the Al spark at 1860 Å the unsensitised quantum yield estimated with the help of Kreusler's absorption data is of the order of unity. It is intended further to determine the relative importance of radiations of 2537 and 1849 Å, respectively, in certain reactions sensitised by Hg vapour. AUTHORS.

2059. Mechanism of Photochemical Reactions with Inorganic Sols. Effect of Light in Different Circularly Polarised States. J. C. Ghosh and T. Banerjee. *Kolloid Zeits.* 86. *pp.* 372–387, *March,* 1939.—A review dealing with circular dichroism in some sols, produced by illumination with circularly polarised light, the mechanism of the photochemical reduction of tungstic acid sols by various reducing agents in non-polarised light, and the effect of pH on this reaction, the mechanism of the photochemical reduction of molybdic acid sols, of vanadic acid with C_2H_5OH in acid solution, and of cerium borate sols. The use of tungstic acid, chromium tungstate, vanadic acid, and $Cr(OH)_3$ sols as photosensitisers in the oxidation of glucose by H_2O_2 is also considered. Photochemical reactions in which some inorganic sols act as activating agents under the influence of right and left circularly polarised light are discussed. A. J. M.

2060. Quantum Efficiency of Photosynthesis. F. F. Rieke. *J. Chem. Phys.* 7. *pp.* 238–244, *April,* 1939.—For the maximum quantum efficiency of photosynthesis in green plants, the value ¼, which was obtained by Warburg and Neglein (1923), has been generally accepted. However this value has appeared to be less certain since only much smaller efficiencies have been observed in recent experiments employing different methods. Because the theoretical aspect of photosynthesis greatly depends upon the maximum quantum efficiency, it is important that additional experiments be made. As a first step toward the solution of this problem, Warburg and Neglein's experiments have been repeated. When their methods are followed closely, a maximum efficiency of 1/4·2 is observed, which is in good agreement with their value. The remaining question—whether this method actually gives the over-all efficiency for the assimilation of CO_2 under favourable conditions, or merely the efficiency for the reduction of a respiration product intermediate between CO_2 and carbohydrate—is not answered by these experiments. Further experiments along this line are in progress. AUTHOR.

2061. Photolysis of Aldehydes and Ketones in the Presence of Iodine Vapour. E. Gorin. *J. Chem. Phys.* 7. *pp.* 256–264, *April*, 1939.—The photolysis of acetone and of formaldehyde takes place principally through a free radical mechanism. The primary processes consist in the splitting off of a methyl radical and a H atom, respectively. The primary process in the photolysis of methyl ethyl ketone also consists in the splitting off of either a methyl or an ethyl radical. The heat of dissociation of the first H in formaldehyde is shown to be as low as 78 kg.cal. Approximately 26 kg.cal. is required to remove the second H atom. AUTHOR.

2062. Photographic Resolution of Lenticular (Strichtraster) Films. H. Frieser. *Zeits. f. wiss. Phot.* 37. *pp.* 261–274, *Nov.–Dec.*, 1938.—A theory is developed to account quantitatively for the experimental results of Sandvik [see Abstract 1163 (1929)]. Particular attention is paid to the effect of the nature of the *Raster* on the resolving power of the film. H. J. H. S.

2063. Supersaturated Solutions of Metallic Silver. Part II. R. E. Liesegang. *Zeits. f. wiss. Phot.* 37. *pp.* 259–261, *Nov.–Dec.*, 1938.—Suggestions are made to account for the high degree of supersaturation which occurs in solutions of metallic Ag and for the changes which take place in the presence of a reducing agent. [See also Abstract 1167 (1939).] H. J. H. S.

2064. Mass and Distribution of Photolytic Ag in AgBr Gelatin Emulsions. W. Meidinger. *Phys. Zeits.* 40. *pp.* 73–77, *Feb.* 1, 1939.—Deals briefly with experimental results which show the effect of temperature on the mass of photolytically obtained Ag for both fine and coarse-grained emulsions. [See also Abstract 175 (1938).] R. C. F.

2065. Reduction of Silver Ions by Hydroquinone. T. H. James. *Am. Chem. Soc., J.* 61. *pp.* 648–652, *March*, 1939.—The reaction between Ag-ion and hydroquinone in slightly acid solution is strongly catalysed by colloidal Ag, Au, Pd and Ag_2S. The rate of the reaction catalysed by Ag varies as the first power of the hydroquinone concentration and as the 2/3 power of the Ag-ion concentration. The dependence of the rate upon the OH-ion concentration indicates that both un-ionised hydroquinone and the univalent ion take part in the reaction in the pH range 5·15–6·27. The rate of the catalysed reaction varies proportionately with the surface of the catalyst, and inversely with the concentration of gum arabic present as stabiliser. The temperature coefficient at pH 5·74 is approximately 2·1. The indicated mechanism involves primary adsorption of Ag-ions to the surface of the catalyst. AUTHOR.

2066. Effect of Experimental Error on Sensitometric Measurements. M. Roulleau and A. Brandricourt. *Soc. Franç. Phot. et Ciné, Bull.* 1. *pp.* 21–29, *Feb.*, 1939.—Cordonnier's system for the quantitative representation of the sensitivity of emulsions is examined critically, particularly in regard to the effect of non-homogeneity of the emulsion and of errors in the measurement of the density. In this system the sensitivity is expressed in terms of the abscissæ of the point of intersection of two tangents having definite slopes, to the "characteristic curve" obtained by plotting density of deposit against log of exposure time. A simplified measure, still based on the characteristic curve, is proposed, for details of which the original should be consulted S. J. G.

2067. Optical Sensitising of Silver Halides by Dyes. Part I. Adsorption of Sensitising Dyes. S. E. Sheppard, R. H. Lambert and R. D. Walker. *Kodak Research Lab. Comm. No.* 703. *J. Chem. Phys.* 7. *pp.* 265–273, *April,* 1939.—The adsorption of a number of sensitising dyes to AgBr has been studied analytically. Basic dyes of the cyanine type are adsorbed completely (irreversibly) from aqueous solutions, but the velocity of adsorption is greatly reduced by the presence of gelatin. Adsorption is oriented, the dye molecules being held by the hydrophile, ionisable side of the molecule, and presenting the hydrophobe portion to the solution, for a primary monolayer ; in several cases a second monolayer is formed with the orientation reserved. Calculations of the adsorption-density at saturation (primary monolayer) agree with "edge-on" adsorption of the dye molecules in approximately close-packed assemblages. In agreement with the spectrographic finding of Leermakers, Carroll and Staud [see Abstract 5307 (1937)] with several of the cyanine dyes, at least two states of aggregation must be assigned to the adsorbed dye. These are provisionally regarded as unimolecular and multimolecular, and show characteristically different absorption and sensitising bands. Acid dyes, such as erythrosin, which contain non-adsorbed solubilising (hydrophile) groups, are incompletely (reversibly) adsorbed, but also appear to be oriented at the surface similarly to the cyanine dyes. Authors.

2068. Photographic Reciprocity Law at Low Temperature. C. H. Evans and E. Hirschlaff. *Kodak Research Lab., Comm. No.* 716. *J.O.S.A.* 29. *pp.* 164–167, *April,* 1939.—The results of measurements of reciprocity law failure at 20° C. and at − 186° C. are given for two different high speed panchromatic emulsions, one low speed unsensitised emulsion, and one high speed orthochromatic emulsion. These measurements, covering the range in exposure time from 1/16 sec. to 17 min. 4 sec. show that in each case the reciprocity law failure, at both high and low intensity, is normal at 20° C., but has disappeared entirely at − 186° C. These results are in complete agreement with those recently published by Berg and Mendelssohn [see Abstract 4492 (1938)]. Authors.

2069. Latent Image Formation at Low Temperatures. W. F. Berg. *Faraday Soc., Trans.* 35. *pp.* 445–458, *April,* 1939.—Experiments on the behaviour of photographic materials at low temperatures were undertaken with the aim of testing the theory, due to Gurney and Mott [see Abstract 665 (1938)] that ionic movements are essential to the formation of the latent image. The application of low temperature arrests ionic movements so that the electronic processes can be studied separately. The conclusions reached earlier that electrons are trapped at low temperature are confirmed, and it is shown that electrons are mostly trapped in the lattice, but also to some extent on the sensitivity specks. The main loss in sensitivity at low temperature is apparently due to recombination of the electrons with Br atoms when the material is warmed up. Author.

2070. Subtractive Colour Photography. R. Reuther and A. Gädeke. *Phot. Indust.* 37. *pp.* 108–112, *Feb.* 1, 1939.—The general principles of subtractive 3-colour photography are discussed and a number of technical processes are described. In each case the absorption spectrum of the colour sensitive film is given. H. J. H. S.

2071. Documentary Photography and Research. S. C. Bradford. *Nature*, 143. *pp.* 393–395, *March* 11, 1939.—Surveys the present position. The various processes are discussed and compared and also their availability. Suggestions are made for making the services of more use to research workers. A. H.

***2072. Viewfinders. K. Martini.** *Phot. Indust.* 37. *pp.* 280–287, *March* 1, 1939.—The author traces the development of the direct type of camera viewfinder with which the operator looks in the direction of the object. The principles of modern viewfinders are explained. W. S. S.

***2073. Film Testing Apparatus. H. Borst.** *Phot. Indust.* 37. *pp.* 331–334, *March* 8, 1939.—With the advent of the miniature camera, and the necessity of producing negatives to stand very large magnification, it has been necessary to modify methods of testing films on account of the fine-grain films required. Several existing testing methods are briefly examined and their faults stated, this being followed by a brief description of the new method and apparatus developed by the present author. The method—a contact method—is stated to result in a reduction in the errors previously introduced by the optical system, a reduction of scattering phenomena by using a parallel beam of light, an improvement due to use of shutter between light source and optical system, a speeding-up of comparison measurements because of film movement, and the possibility of giving accurate figures for the negative material, using a definite testing developer. R. C. F.

***2074. Blackening Measurements of Photographic Paper Positives. W. Falta.** *Zeits. f. wiss. Phot.* 37. *pp.* 247–258, *Nov.–Dec.*, 1938. —Derives several approximate formulæ for the reflection of light from photographic paper positives, and examines the influence of the type of illumination on the surface reflection. Experimental results obtained show that a straight line law exists between reflecting power and illumination conditions, the latter being varied by mixing direct and diffuse light. It is also shown from a large number of statistical comparisons that the best type of illumination for practical picture viewing is one in which the diffuse light content is 0·24 of the total. A description of the photometer used is given, and a suggestion made regarding a practical illuminating system, the importance of the type of illumination being indicated by two gradation curves—one for glossy and the other for matt paper. R. C. F.

***2075. Method of Monochromatic Photography. H. Takô.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 875. *pp.* 175–181, *Feb.*, 1939. *In English.*—An apparatus is described for taking a number of monochromatic photographs simultaneously. A beam of light is passed through a slit and then through the usual spectrographic arrangement of a lens, direct-vision prism, and lens, the latter being placed so that a real image of the slit is obtained. The monochromatic beam is isolated by placing a second slit at this point, or if a number of monochromatic beams are required several slits are arranged laterally. An image is obtained by placing a third lens or a many-faced compound prism after the third slit. The apparatus is used to photograph a sodium discharge and an incandescent electric lamp. F. J. L.

2076. Photochemical Models in Photographic Science. F. Weigert. *Phot. J.* 79. *pp.* 121–131, *March*, 1939.—Deals with photographic science from chemical and physical viewpoints, discussing photodichroism, the method for its determination, and the rôle it plays in photography. Simple cases which demonstrate a drop in sensitivity brought about by the light itself are then described, and, finally, the relationship of these experiments with the latent photographic image is discussed.

R. C. F.

See also Abstracts 1964, 2079, 2080, 2120.

PHOTOMETRY.

2077. Spectral Luminosity Curve of the Eye by Flicker Photometry. M. Jaggi. *Helv. Phys. Acta*, 12. 2. *pp.* 77–108, 1939. *In German.*—The spectral luminosity curve was measured directly by matching monochromatic light with a fixed white light, the energy value of the monochromatic light being determined by a photoelectric method. The curve was also arrived at by an indirect method in which light of known colour temperature in combination with various colour filters was compared with white light. The results by the two methods agreed satisfactorily and gave a curve with its maximum at about 565 $m\mu$, as against 555 $m\mu$ for the internationally agreed luminosity curve. There was some difference in shape between the curves apart from the shift in the maximum. The effects of such factors as the brightness and angular size of the matching field, the presence of a surround field, the colour of the comparison light and the validity of the additive law were also studied. The surround field used had a special character in that it extended not only round but also over the matching field. It was found to have little effect on the results.

W. S. S.

***2078. Spectrophotometry of Reflecting Materials. R. Donaldson.** *Journ. Sci. Instruments*, 16. *pp.* 114–117, *April*, 1939.—A method of adapting a photoelectric spectrophotometer to the measurement of reflecting materials is described. The specimen is illuminated normally and all the light diffused by the specimen between angles of 35° and 55° is focused on the photo-cell by reflection from a spherical concave mirror. The C.I.E. conditions for the illumination and viewing of reflecting materials in colour measurement are thus closely adhered to, while the sensitivity of the spectrophotometer does not fall below 0·3 of its value when measuring transparent specimens.

AUTHOR.

See also Abstract 2074 and

1178B. Terminology and Standards of Illumination. E. C. Crittenden.
1179B. Basic Principles in Illumination Calculations. P. Moon.

POLARISATION.

2079. Theory of Transverse Photodichroism. S. Nikitine. *Comptes Rendus*, 208. *pp.* 643–646, *Feb.* 27, 1939.—Previous work [see Abstract 1641 (1939)] on the origin of photodichroism is now developed for the following cases, the light being considered to travel in the axis Oz : (*a*) Electric vector parallel to Ox : the photodichroism in direction Oy is the same as that predicted for Oz. (*b*) Electric vector parallel to Oy : no dichroism is to be expected. (*c*) Electric vector perpendicular to Oz (natural light) : a measurable transverse dichroism should be expected. [See following Abstract.]

C. B. A.

2080. Anisotropy of Absorption of Light by Molecules of Photosensitive Dyes. S. Nikitine. *Comptes Rendus*, 208. *pp.* 805–807, *March* 13, 1939.—The variation with wave-length of the photodichroism produced by a given irradiation in polarised white light is measured for thin films of cyanine, pinacyanol and eosine. In each case, photodichroism increases with wave-length. [See preceding Abstract.] C. B. A.

See also Abstracts 1891, 2059, 2076, 2089.

REFLECTION, REFRACTION AND DISPERSION.

2081. Reflections inside an Infinite Cylinder. W. F. Whitmore. *J. Math. Phys.* 17. *pp.* 218–232, *Jan.*, 1939.—It is shown that the integral equation determining the inter-reflections of radiation in an infinite circular cylinder can be reduced to a second-order differential equation, the assumption being that initial luminosity and reflection factor vary round but not along the cylinder. The special cases of constant reflection factor, cylinder with longitudinal slit and cylinder with piecewise constant reflection factor are solved analytically. Possible methods of attack on the more difficult problem of a cylinder of arbitrary cross-section are suggested. W. S. S.

2082. Convergent Pencils. L. Lenouvel and F. Lenouvel. *Rev. d'Optique*, 17. *pp.* 350–361, *Oct.*, 1938.—The fringes given by the gratings used in testing objectives for aberrations are unsatisfactory in some respects. The authors describe an alternative device which consists essentially of a Michelson interferometer in a single prism which cannot be thrown out of adjustment. The fringe systems obtained are simpler and give more information, in particular, in the determination of the meridian of the wave surface. A Wollaston prism may be substituted for the interferometer and gives a considerably greater light intensity. W. S. S.

2083. Homogeneity of Glass. F. J. Hurlbut. *Soc. Glass Technol. J.* 22. *pp.* 280–291, *Dec.*, 1938.—The homogeneity of tank glass is discussed in relation to the size and shape of the tank; method of firing; viscosity, surface tension and molecular diffusion of the glass at the various temperatures obtaining in the tank; and the method of addition of cullet. F. S.

***2084. Electric Counter for Thin-Section Analysis. C. S. Hurlbut, Jr.** *Am. J. Sci.* 237. *pp.* 253–261, *April*, 1939.—The electric counter consists of two parts, a recording unit and a mechanical microscope stage joined to one another by a flexible cable. Six minerals can be measured and recorded at one time according to the Rosiwal method. Traverses are made alternately to the right and left across the thin section, and the totals of all the traverses are carried on the counters of the recording unit. A total counter automatically adds the sub-totals of the other counters, and thus eliminates the recording and adding of many readings. The electric counter enables one to make a micrometric measurement of a thin section in less than half the time taken by other methods. It has the additional advantage of permitting the thin section to lie directly on the microscope stage. AUTHOR.

See also Abstracts 1897, 2074, 2078.

SPECTROSCOPY.

***2085. Emission Spectra in Analysis. R. Intonti.** *Chim. e l'Industria*, 20. *pp.* 726–731, *Nov.*, 1938.—The author discusses the applicability of the following sources of emission spectra: (1) Bunsen flame; (2) Lundegårdh pulveriser; (3) electric arc; (4) flaming arc; (5) interrupted arc; (6) condensed spark; (7) high frequency. Special attention is given to the method of Gerlach, based on the intensity of a line of the alloying addition measured at a distance l between two points of a line of the fundamental element. Methods are classified into qualitative, semi-quantitative and quantitative. D. R. H.

2086. Temperature Classification of Europium Lines. A. S. King. *Mt. Wilson Observat., Contrib. No.* 608. *Astrophys. J.* 89. *pp.* 377–430, *April*, 1939.—The paper gives wave-length measures and temperature classifications for 3950 Eu lines from λ2100 to λ10165. Of these, slightly less than 2200 belong to neutral Eu. A very large intensity range is found for both neutral and singly ionised lines. Many of the former are relatively stronger in the furnace than in the arc. The absorption furnace spectrum was used to obtain low-level lines in the u.v. to λ2659. Lines of Eu II, selected by comparison of arc and spark spectra, range from low-level furnace lines to those much enhanced in the spark. An u.v. spark spectrum, which is absent from the arc, probably belongs to Eu III. In addition to arc and furnace intensities, the degree of widening, due to hyperfine structure, of a large proportion of the lines is indicated in a table. Close agreement of lines in the sunspot spectrum with the ultimate lines of Eu I indicates the presence of neutral Eu in the solar atmosphere. Additional identifications of Eu II lines in the sun have been made. Approximately three-fourths of the lines ascribed by Eder to a suggested unknown substance "eurosamarium" have been identified as belonging to known rare earths, nearly half being lines of Eu. Seventeen bands of $EuCl_3$ appearing in the furnace spectrum from λ5695 to λ7450 have their limiting wave-lengths given and their distinctive features described. [See also Abstract 1253 (1931).] AUTHOR.

2087. Short-Wave Optical Spectral Lines with Curved Crystal as Diffraction Grating. H. Flemberg. *Zeits. f. Physik*, 111. 11–12. *pp.* 747–749, 1939.—Photographs are given of five spectral lines in the wave-length region 18·5 to 15·0 Å in the spark spectra F VIII, Cr XV and Fe XVII. These were registered with the use of a high vacuum spectrograph, a curved crystal serving as diffraction grating. J. J. S.

2088. Absolute Intensity of Zinc Resonance Line, 2138·6 A. Line Form and Vapour Pressure of Zinc. J. Ausländer. *Helv. Phys. Acta*, 12. 2. *p.* 168, 1939. *In German.*—Corrections to the original [see Abstract 703 (1939)].

2089. Intensity Dissymmetry in the Light Emitted by Ne and A Canal Rays. H. Angenetter and H. Verleger. *Phys. Zeits.* 40. *pp.* 113–116, *Feb.* 15, 1939.—In continuation of previous work [see Abstract 2461 (1938)], polarisation and intensity dissymmetry are measured for a number of spectral lines emitted by canal rays in Ne and A discharge tubes. C. B. A.

2090. Molecular Beam Resonance Method for Measuring Nuclear Magnetic Moments. I. I. Rabi, S. Millman, P. Kusch and J. R. Zacharias. *Phys. Rev.* 55. *pp.* 526–535, *March* 15, 1939.—A new method of measuring nuclear or other magnetic moment is described. The method, which consists essentially in the measurement of a Larmor frequency in known magnetic fields, is of very general application and capable of the highest precision in absolute and relative measurements. The apparatus consists of two magnets in succession which produce inhomogeneous magnetic fields of oppositely directed gradients. A molecular beam of the substance to be studied possesses a sigmoid path in these magnets and is focused on a suitable detector. A third magnet which produces a homogeneous field is placed in the region between the two deflecting magnets. In this strong homogeneous field the nuclear moments are decoupled from other nuclear moments and from rotational moments of a molecule in a $^1\Sigma$ state, and precess with their Larmor frequency $\nu = \mu H/hI$. An oscillating field perpendicular to the homogeneous field produces transitions to other states of space quantisation when the frequency of this field is close to ν. If such transitions take place the molecule is no longer focused on to the detector by the subsequent inhomogeneous field and the observed intensity diminishes. The application of the method to the molecules LiCl, LiF, NaF and Li_2 is described. The nuclear moments of Li^7, Li^6 and F^{19} were found to be 3·250, 0·820 and 2·622 nuclear magnetons, respectively. [See following Abstract.]

AUTHORS.

2091. Determination of Signs of Nuclear Magnetic Moments by Molecular Beam Method of Magnetic Resonance. S. Millman. *Phys. Rev.* 55. *pp.* 628–630, *April* 1, 1939.—It is shown that the molecular beam magnetic resonance method for measuring nuclear magnetic moments [see preceding Abstract] is capable of determining the sign of a nuclear moment even though an oscillating perturbing field is substituted for the rotating field required by the theory. The sign determination is obtained from an asymmetry in the resonance curve introduced by the end effects of the oscillating field. The signs of the nuclear moments of Li^6, Li^7 and F^{19} were found to be positive, in agreement with known results. AUTHOR.

2092. Calculation of Atomic Energy Levels. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 47–51, *Feb.*, 1939. *In English.*—The energy expressions of an atom or ion for configurations containing more than 3 electrons have already been considered [see Abstract 4522 (1938)]. In this extension of the work the bulk of the operational details are omitted and only the final results given. A. H.

2093. (OH_V) Bands of Acid Vapours. A New Harmonic. P. Barchewitz. *Comptes Rendus*, 208. *pp.* 807–809, *March* 13, 1939.—The second and third harmonics of the (OH_V) band at 2·79 μ (the latter for the first time) are studied for the vapours of the first six fatty acids, for benzoic and *o*-chlorbenzoic acids, and for halogen derivatives of acetic acid, and the results are compared with those obtained for the corresponding alcohols. The (OH_V) bands can be represented by the formula $\nu_n = 3696n(1 - 0{\cdot}0259n)$. C. B. A.

2094. Infra-Red and Raman Spectra of Triborine Triamine. B. L. Crawford, Jr. and J. T. Edsall. *J. Chem. Phys.* 7. *pp.* 223–232, *April*, 1939.—The Raman spectrum of liquid $B_3N_3H_6$ has been studied, and the infra-red absorption of the gas measured from 2·5 to 24·5 μ. The molecule is assumed to be isoelectronic with benzene, belonging to the point group D_{3h}, and an assignment of fundamental frequencies is given, based upon this structure. A normal coordinate treatment has been made, and used to calculate the three inactive frequencies and the isotope shifts due to the B^{10} isotope. The agreement between calculated and observed values is satisfactory except for the nonplanar frequencies, where strong interactions between bonds attached to the aromatic ring in metapositions are indicated. The fundamental frequencies of triborine triamine are compared with those of benezene; satisfactory correlation is obtained with the benzene frequencies given by Lord and Andrews. The frequencies of the triborine triamine are used together with structural data to calculate the thermodynamic properties of the substance. AUTHORS.

2095. Far Infra-Red Absorption Spectra (20-60 μ) of Halogen Derivatives of Methane and Monosubstituted Derivatives of Benzene. P. Barchewitz and M. Parodi. *J. de Physique et le Radium,* 10. *pp.* 143–150, *March,* 1939.—Data on the far infra-red (20-60 μ) absorption spectra of CX_4 (X = Cl, Br), CH_2Y_2, and CHY_3 (Y = Cl, Br, I), confirm theoretical predictions. The resolution of the bands agrees with the data obtained from the diffusion spectra. Some of the bands are identified with various modes of vibration of the molecules. The modes of vibration active in the absorption spectra in the region 20–60 μ of PhX (X = H, Me, NH_2, CN, OMe, NO_2, Cl, Br, I) are discussed. W. R. A.

2096. Red and Near Infra-Red Absorption Spectra (6000–10,000 Å). P. Barchewitz. *Ann. de Physique,* 11. *pp.* 261–350, *March,* 1939.—Absorption curves in the region 6000 to 10,000 Å have been obtained directly for saturated, ethylenic, and benzene hydrocarbons and their derivatives, and for alcohols and amines, using an arrangement of spectrograph and photo-cell. In the saturated hydrocarbons the third, fourth, and fifth harmonics of the fundamental CH band are visible. For the normal compounds each harmonic consists of 2 components. The component situated at short wave-length (I) has a constant intensity for all members of the homologous series and is assigned to CH_3; whilst the other (II) becomes more intense on mounting the homologous series and arises from CH_2. These bands are displaced towards greater wave-lengths as the chain length increases. In the isomeric hydrocarbons (I) increases in intensity whilst (II) tends to disappear. In the 1 : 2-ethylenic hydrocarbons three new bands are visible, one characteristic of HC= and the other two probably to H_2C=. For ethylenic hydrocarbons in which the double bond is not at the end of the chain, however, the two H_2C= bands disappear, leaving only the HC= band. The CH bands of the halogen derivatives of saturated hydrocarbons are displaced to short wave-lengths relative to their position in the hydrocarbons, due probably to the electric moment of the C-halogen vibrators. The NH bands in primary and secondary acyclic amines are displaced to shorter wave-length on mounting the homologous series. OH bands of alcohols are not visible in the studied spectral region at ordinary temperature, but appear at approximately 60° and increase in intensity up to the critical temperature; at the same time the bands are displaced to shorter wave-lengths. The displacements and increase in intensity on dilution of the OH bands is due to association. W. R. A.

2097. Infra-Red Absorption of Acrolein. P. Lambert and J. Lecomte. *Comptes Rendus,* 208. *pp.* 740–742, *March* 6, 1939.—The absorption spectrum of acrolein vapour in the infra-red (500–1400 cm^{-1}.) has been investigated. The principal maxima are at 727, 919, 957, 1124, and 1369 cm^{-1}. The band at 1124 cm^{-1}. is particularly narrow, indicating the absence of polymerisation. The absorption spectrum of acrolein gel obtained by polymerisation is similar to that of the vapour but the three bands at 919, 957 and 1214 cm^{-1}. are replaced by very wide and intense bands. Comparison with the Raman spectrum shows that the u.v. light used in the investigation of the latter causes polymerisation. Comparison with the spectra of compounds of the type CH_2 : CH.X (X = CH_3, Cl, Br, I, etc.) enables the bands to be classified to some extent. The 727 cm^{-1}. band is displaced towards the lower frequencies as the mass of X is increased, indicating that this is a frequency characteristic of the link C-X. The band at 1124 cm^{-1}. is probably due to the CHO group. A. J. M.

2098. U.V. Absorption Spectra of Solid Oximes. T. Guilmart. *Comptes Rendus*, 208. *pp*. 574–576, *Feb*. 20, 1939.—Measurements of the absorption spectra of various oximes in the solid state confirm that these substances, both as solid and in solution, exist in two forms having very different spectra. The isomerism probably depends on a difference in the valency angles of the atoms of the functional group. C. B. A.

2099. U.V. Absorption Spectra of Acid Chlorides and Bromides. S. Vencov. *Comptes Rendus*, 208. *pp*. 801–803, *March* 13, 1939.—The absorption spectra of a number of acid chlorides and bromides have been studied. Acetyl chloride gives a predissociation spectrum, with 25 to 30 bands, having a marked regularity. This spectrum appears to be composed of two band systems corresponding to successive vibrational states. The limit of predissociation is fixed at 2820 Å (100·9 kg. cal.), and the mechanism $CH_3COCl = CH_3 + Cl + CO$ is suggested for it. C. B. A.

2100. New U.V. Band System of AgI. N. Metropolis. *Phys. Rev.* 55. *pp*. 636–638, *April* 1, 1939.—A new u.v. band system of AgI has been photographed in absorption at temperatures 700–900° C. At higher temperatures the system is overlapped by strong continuous absorption, which advances gradually from shorter wave-lengths. The new system lies at 2300 Å, *i.e.*, at shorter wave-lengths than the known system, and its lower state vibrational constants agree with those given by Brice for the lower state of the longer wave-length system. The rotational structure and the very small isotope effect are not resolved. The equation for the band heads may be written:

$$\nu_h = 44{,}724 + 152\cdot 8(v' + \tfrac{1}{2}) - 1\cdot 1(v' + \tfrac{1}{2})^2 - 205\cdot 1(v'' + \tfrac{1}{2}) + 0\cdot 43(v'' + \tfrac{1}{2})^2.$$

This formula is based upon progressions from $v' = 0$ to $v' = 4$ and from $v'' = 0$ to $v'' = 11$. An additional new band system was found at 2150 Å, and the wave numbers of the band heads may be represented by the following formula:

$$\nu_h = 45{,}487 + 176(v' - b + \tfrac{1}{2}) - 2\cdot 5(v' - b + \tfrac{1}{2})^2 - 205(v'' - a + \tfrac{1}{2}) + (v'' - a + \tfrac{1}{2})^2$$

The values of a and b could not be determined. AUTHOR.

2101. Analysis of Near U.V. Electronic Transition of Benzene. H. Sponer, G. Nordheim, A. L. Sklar and E. Teller. *J. Chem. Phys.* 7. *pp*. 207–220, *April*, 1939.—The absorption spectrum of benzene at 2800–2200 Å has been analysed. The vibrational structure of the system has been found to be in agreement with the selection rules for a forbidden transition ($^1A_{1g} \rightarrow B_{2u}$). The transition becomes possible when vibrations of type $E_g{}^+$ distort the molecule. Only carbon frequencies have been found to be effective. The interpreted data are collected in series. The analysis is corroborated by comparison with the absorption of solid benzene at − 259° C., with the absorption spectrum of heavy benzene and with the fluorescence spectra of both benzenes. AUTHORS.

2102. Absorption Band of Formaldoxime at λ9572. L. R. Zumwalt and R. M. Badger. *J. Chem. Phys.* 7. *pp*. 235–237, *April*, 1939.—The third harmonic of the O — H band in formaldoxime vapour has been found to lie at λ9572 (10,444·1 cm^{-1}.) and under high dispersion has been resolved and found to resemble a parallel band of a symmetric rotator. Owing to the weakness of the lines near the centre of the band a definitely unique rotational analysis could not be made but the harmonic mean of the two larger moments of inertia appears to lie between the limits 73·3 and 76·6 $\times 10^{-40}$ gm.cm^2. The hydroxyl hydrogen does not rotate freely and indeed its torsional oscillation appears not to have a very low frequency. It is not possible to locate this hydrogen uniquely until other parameters of the molecule have been determined by electron diffraction. The possible effect of resonance on the O — H frequency is discussed.

AUTHORS.

2103. Interpretation of Molecular Spectra in Celestial Objects. *Astrophys. J.* 89. *pp.* 283–319, *March*, 1939.—Comprises 11 contributions to a symposium held at the Yerkes Observatory in June, 1938.

" Intensities of Electronic Transitions in Molecular Spectra," by **R. S. Mulliken** (*pp.* 283–288).—Discusses the theoretical calculation of absolute intensities, *i.e.*, absolute emission or absorption probability coefficients, of the electronic bands in molecular spectra. As illustrating the method there is calculated the over-all intensity of the first two of the u.v. absorption systems of H_2 molecule.

" Forbidden Transitions in Diatomic Molecules," by **G. Herzberg** (*pp.* 288–289).—The reasons for the appearance of forbidden transitions, *i.e.*, transitions violating the ordinary selection rules, are discussed; also the light that these throw on conditions in celestial objects.

" Dissociation, Predissociation and Recombination of Diatomic Molecules," by **G. Herzberg** (*pp.* 290–292).—A general discussion of dissociation, predissociation, etc., with applications to cometary spectra and the large Doppler width of the coronal lines.

" Infra-Red Spectrum of Water Vapour," by **D. M. Dennison** (*pp.* 292–294).—A survey of present knowledge of this subject.

" Influence of Pressure and Temperature upon the Absorption and Fluorescence of Spectral Lines," by **H. Beutler** (*p.* 294).—A general discussion of shifts and shapes of lines and the forces tending to affect these.

" Continuous Spectra," by **G. H. Shortley** (*p.* 295).—Apart from a general discussion of the subject a new method of calculating the relative probabilities of transitions into the various levels of an atomic configuration in the case of electron capture by an ion was reported.

" Electron Affinity in Astrophysics," by **R. Wildt** (*pp.* 295–301).—Discusses the rôle which may be played by negative ions, *i.e.*, neutral atoms or molecules to which are attached electrons in stationary states, in stellar atmospheres. The application to the opacity of stellar atmospheres is considered.

" Molecular Bands in Stellar Spectra," by **N. T. Bobrovnikoff** (*pp.* 301–310).—The effect of observational technique on the detection of bands in different types of stars is first considered. Then it is pointed out that so far the existence of no polyatomic molecule has been established in the case of stars. The molecules which have been detected are discussed and the information they give re stellar conditions considered. Actually, some 27 diatomic molecules have been identified in stellar spectra and most of these occur in the spectrum of the sun. The abundance of the various types of molecules in the stars is examined and, finally, a number of outstanding problems are indicated.

" Molecular Bands as Indicators of Stellar Temperatures and Luminosities," by **W. W. Morgan** (*pp.* 310–311).—It is found that the strong visual TiO bands can be used for classifying the brighter K and M dwarfs. It is concluded that from the spectral type alone, determined from the intensity of the strong TiO bands in the visual region, the following data concerning M dwarfs can be obtained from reduction-curves based on well-observed stars: the absolute magnitude, the effective temperature, the stellar diameter.

" Spectroscopic Studies of Planetary Atmospheres," by **A. Adel** (*pp.* 311–312).—The analysis of planetary spectra is applied to the deduction of such physical properties of planetary atmospheres as atmospheric composition and temperature. The topics discussed include the telluric spectrum, and planetary emission and absorption spectra.

" Interpretation of the Spectra of Comets and their Forms," by **K. Wurm** (*pp.* 312–319).—A description of the outstanding features of the observations on comets is first given. The explanation of the luminescence as a fluorescence phenomenon is then examined. The facts show clearly that extremely low density atmospheres have to be postulated and that collisions play no part. The two processes which must play an important rôle—ionisation and dissociation by light absorption—are discussed at length. The explanation put forward accounts quite naturally for a number of facts, *e.g.*, that the CN and C_2 molecules do not appear in the tail. A. H.

2104. Calculation of Equilibrium Internuclear Distance for Diatomic Hydrogen, Hydrides and Deuterides in Ground and Excited States. C. H. D. Clark and J. L. Stoves. *Phil. Mag.* 27. *pp.* 389–403, *April*, 1939.—Pursuant to an earlier investigation on non-hydrides [see Abstract 4962 (1938)] a systematic analysis is made of the comparative merits of formulæ for calculating equilibrium internuclear distance of hydride di-atoms proposed by Huggins, Allen and Longair, Badger, and the authors. It is found necessary to take account of electron configuration as well as period and group when assigning suitable constants. With such allowances the authors' formula reproduces the experimental results for hydrides with the least average error (1·4%). The investigation been extended to HH, HD, and DD, and to deuterides for which experimental numbers are available, with similar results. A discussion of the influence of isotopes leads to the conclusion that a simple correction in the authors' formula, applied to deuterides, is successful. AUTHORS.

2105. Dissociation of Diatomic Hydrides and Deuterides. L. Gerö and R. Schmid. *Zeits. f. Physik*, 111. 9–10. *pp.* 588–595, 1939.—On the assumption that the lowest band terms are convergent towards higher atom term combinations, many of the difficulties encountered in the analysis of hydride and deuteride band terms are overcome. This assumption explains the observation of Σ^--terms, the discrepancy between the the value of the convergence limits and the limit of predissociation in the hydride bands, the so-called " superfluous " molecule terms, and the high spin resolution of the multiplet-Σ-hydride terms; and it avoids the assumption that a number of hydride band terms should give rise to potential curves which would have a maximum at finite nuclear separations even in the rotationless state. C. B. A.

2106. Perpendicular Vibrations of NH_3. E. F. Barker. *Phys. Rev.* 55. *pp.* 657–662, *April* 1, 1939.—The vibration frequency ν_2 of NH_3 is identified by means of the combination bands $\nu_2 \pm \nu_3$ at $2\cdot2\mu$ and $4\cdot0\mu$, in each of which the spacing between component bands is about 16 cm^{-1}. From the difference band the numerical value of ν_2 is fixed at 3415 cm^{-1}. The fundamental band may be recognised in the weak and complex background of the absorption at 3μ. The coefficient ζ_2 of the vibrational angular momentum is approximately $+0 \cdot 6$. The second perpendicular fundamental band at 6μ is partially resolved, and is in good agreement with the expected pattern if ζ_4 equals $-0 \cdot 3$. The indicated value of ν_4 is 1628 cm^{-1}. The numerical values of ζ_2 and ζ_4 do not agree well with those predicted theoretically. The parallel component of $2\nu_4$ is found at 3220 cm^{-1}., and two pairs of parallel combination bands, $\nu_1 + \nu_3$ at 4270 and 4303 cm^{-1}. and $2\nu_4 + \nu_3$ at 4177 and 4217 cm^{-1}. AUTHOR.

2107. Zeeman Effect of Forbidden Lines of K. F. A. Jenkins and E. Segrè. *Phys. Rev.* 55. *pp.* 545–548, *March* 15, 1939.—The Zeeman effect of the lines S — S and S — D, absorbed by K vapour in an electric field of about 2000 V/cm. is studied. A magnetic field of 27000 gauss was obtained by using the magnet of the new Berkeley cyclotron. The lines 4S — 14S to 4S — 19S show no effect, except for a slight broadening of the last one or two lines. The Zeeman patterns for 4S — 12D to 4S — 15D, with the magnetic field perpendicular to the electric field and to the direction of observation, are resolved. They agree with the predicted pattern 0(1)2/1, and show qualitatively the expected intensities. AUTHORS.

2108. Intensity Relations of Stark Components in Hydrogen. Part II. N. Ryde. *Zeits. f. Physik*, 111. 11–12. *pp.* 683–707, 1939.—The intensities of the Lyman, Balmer, Paschen, and Brackett lines with initial states $n \leqq 5$ are calculated on the assumption that the same number of atoms arrive in unit time at each Stark effect level (dynamic excitation), and these intensities are compared with those calculated on the assumption that the same number of atoms are present in each Stark effect level in the same time interval (static excitation). Simple formulae are derived for the matrix components and the sum of their squares. The transition probabilities of the lines and the life period of the initial states are calculated. It is shown that theory requires different widths of lines for different line components. For the higher field strengths the life periods of symmetrical levels differ markedly from each other. The results of the theory are compared with experiment, and there is in general good agreement. [For Part I see Abstract 2906 (1938).] A. J. M.

2109. Raman Spectrum of Deutero-Salicylic Aldehyde. G. B. Bonino and R. Manzoni-Ansidei. *Accad. Lincei, Atti*, 28. *pp.* 259–264, *Nov.* 5, 1938.—The authors have continued their study of the Raman spectra of salicylic aldehyde by replacing the H of the OH bond by D. They obtained the deuterated compound by treating the ordinary salicylic aldehyde with Al_2Cl_6 and regenerating the trichloride compound with D_2O. This procedure furnishes a pure deutero-salicylic aldehyde in which the O-H bond has been changed into an O-D bond. The Raman spectra of the ordinary salicylic aldehyde and the deutero-compound are tabulated. The results show that the Raman spectrum makes it doubtful whether the salicylic aldehyde possesses a hydrogen bond between the O-H and the $C = O$ linkages. The lines associated with the $C = O$ group are complex in both cases; the 1660-line is the same for both compounds, while the line near 1642 is shifted to lower frequencies for the deutero-compound. L. K.

2110. Raman Spectra of Liquid Solutions. A. E. Brodskii, A. M. Sack and L. V. Kortchagin. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 105–108, *Feb.*, 1939.—The Raman frequencies of $AsCl_3$ are not shifted in benzene and CCl_4, but in methyl, ethyl, and isopropyl alcohols certain frequencies are greatly diminished. $SbCl_3$ behaves similarly, whereas none of the frequencies of PCl_3 are changed by solution in $CHCl_3$, CS_2 and ether. In all cases the solvent frequencies are unaffected. $AlCl_3$ in water shows only H_2O frequencies. The shifts cannot be due solely to difference in dipole moments of solute and solvent respectively, and the authors suggest that the solvent dipole can shift the frequency due to a given solute bond only if the force constant of the latter is sufficiently weak. The 1048 cm^{-1}. frequency of NO_3^- in solutions of KNO_3 and $NaNO_3$ is not shifted in presence of Li^+ or sucrose due to the screening effect of the solvent envelopes. S. J. G.

2111. Raman Spectra of Hexanes and Heptanes. E. J. Rosenbaum, A. V. Grosse and H. F. Jacobson. *Am. Chem. Soc., J.* 61. *pp.* 689–692, *March,* 1939.—The Raman spectra of the five hexanes and the nine heptanes are described. AUTHORS.

2112. Raman Spectra of Crystalline Ammonium Nitrate and Sulphate. H. Volkringer, M. Freymann and R. Freymann. *Comptes Rendus,* 208. *pp.* 1005–1007, *March* 27, 1939.—The Raman spectra are photographed for NH_4NO_3 and $(NH_4)_2SO_4$ at temperatures from −192° C. to +170° C., using the method of complementary filters. Discrepancies thought previously to exist between the authors' results and those of Ananthakrishnan [see Abstract 1701 (1937)], are found to be illusory, since the two sets of results refer to different temperatures, between which a change in crystalline form occurs. In the nitrate, the lines in the region 3000 cm^{-1}. show definite changes as the crystalline form changes. At −192° C. there are lines at 3050, 3116, 3188 and 3220. At −75° C. and down to −20° C. the first two lines widen, and are slightly shifted, while the last two become fused into one band. The crystalline form then changes from cubic to rhombohedral, and at 15° C. only bands at 3135 and 3220 remain. Above 32° C. (change to monoclinic form) these two bands become fused in one band at 3156. This band is unchanged as the temperature is raised to 170° C. These results are consistent with the allocation of 3050 to the symmetric vibration ν_1 of NH^+_4 and 3116, 3188, 3220 to the triply degenerate vibration ν_3, the degeneracy being resolved by the influence of the NO'_3 ion at the low temperature. The sulphate shows similar behaviour to that of the nitrate. A. C. M.

***2113. Vacuum Grating Spectrograph Mounting. W. R. S. Garton.** *Journ. Sci. Instruments,* 16. *pp.* 117–121, *April,* 1939.—A vacuum grating spectrograph for use in the extreme u.v. has been designed and constructed, in which the mounting of the grating is on the Eagle plan, and all essential movements are produced from without the evacuated envelope. By means of a lock between the plate-chamber and main tube, the time necessary for pumping and adjustments is minimised. AUTHOR.

***2114. Electrical Sparks and their Application to Excitation of Spectra. H. Kaiser and A. Wallraff.** *Ann. d. Physik,* 34. 4. *pp.* 297–340, *Feb.,* 1939.—This paper describes a thorough investigation of the theory and application of spark discharge sources in quantitative spectrum analysis, it contains such a wealth of data as to be unsuitable for abstracting and readers interested in this subject are advised to consult the original. The investigation has three main objectives : (1) to check and collate the results of the most important prior investigations of spark sources ; (2) to extend knowledge of the fundamental processes in spark discharges ; (3) investigation of technical apparatus for spark discharge, in particular the Feussner generator, a h.f. l.v. spark discharge controlled by a synchronous rotary generator, an arrangement shown to be superior in most respects to uncontrolled spark circuits as a spectroscopic source. J. E. K.

2115. Light Excitation by Ion and Atom Collisions. W. Maurer. *Phys. Zeits.* 40. *pp.* 161–181, *March* 1, 1939.—The author gives a résumé of existing knowledge of excitation by the collision of ions and atoms with the subsequent emission of light. The following topics are dealt with: sources of ions, form of the excitation function, excitation of both partners in the collision, excitation by protons, alkali ions and the atoms H and D, transfer of momentum and the conservation of the spin in collisions, absolute light yield. W. S. S.

2116. Calculation of Luminous Efficiency of Ionised Caesium Vapour. F. L. Mohler. *J.O.S.A.* 29. *pp.* 152–157, *April*, 1939.—Theoretical computations are given for the radiation and electrical characteristics of the Cs discharge for pressure and power input above the range of present experimental technique. For a given pressure and temperature the electron concentration is given by Saha's equation, the resistivity depends on the temperature and electron concentration and for sufficiently high pressures the power input is not much greater than the total power radiated by the vapour. The power radiated is evaluated from values of the emissivity times the radiant flux of a black body at the vapour temperature. Graphical integrations gives the total radiant and luminous flux. An optimum luminous efficiency of about 180 lumens per watt is estimated for a fairly wide range of conditions around tube dia. 1 cm., pressure 176 mm., and temperature 6000° K. This requires a current of about 300 A and a gradient of 22 V/cm. The brightness temperature is 5400° K. and the colour temperature roughly 3700° K. At 760 mm. the brightness and colour are nearly those of a black body. Values for various conditions are tabulated. [See Abstracts 379 and 783 (1939).] AUTHOR.

See also Abstracts 2053, 2115, 2138, 2185.

TRANSMISSION.

2117. Maximum Depth of Visibility in Suspensions. A. Marcelin. *Comptes Rendus*, 208. *pp.* 889–891, *March* 20, 1939.—Describes an apparatus for determining the turbidity of dense suspensions. The method depends upon the depth within a suspension at which the engravings on a test plate disappear. A. H.

See also Abstracts 1954, 1995.

VISION.

2118. Temperature and the Critical Intensity for Response to Visual Flicker. Part II. W. J. Crozier. *Nat. Acad. Sci., Proc.* 25. *pp.* 78–82, *Feb.*, 1939.—Further data are reported on the shift in the curve of flash-frequency against flash-intensity for critical flicker when the temperature of the animal is varied. The results for *anax* nymphs and the sunfish *enneacanthus* suggest that two concurrent chemical reactions with different "activation energies" contribute to the control of the observed flicker frequency. [For Part I see Abstract 3283 (1938).] W. S. S.

2119. Directional Sensitivity of the Retina and the Spectral Sensitivities of the Rods and Cones. W. S. Stiles. *Roy. Soc., Proc.* 127*B*. *pp.* 64–105, *March*, 1939.—The primary object of this work was to determine how threshold sensitivity varies with the angle of incidence of the light on the retina but the results cover the wider problem of the dependence of threshold sensitivity on the intensity and wave-length of the field to which the retina is adapted. Threshold sensitivity was measured by the smallest perceptible intensity of a flashing test-spot of monochromatic light. For the dark-adapted eye it was found that for foveal vision direction of incidence on the retina had a pronounced effect on sensitivity at all wave-lengths. For parafoveal vision, there was practically no effect save in the red. The changes in threshold on adapting the retina to increasing intensities of coloured light are explained by assuming four groups of retinal receptors (rods and three kinds of cone) whose approximate spectral sensitivity curves are determined. The variation in sensitivity with angle of incidence was found to be different for each receptor group. W. S. S.

2120. Visual Perception of Contrast at Different Adaptation Levels. R. G. Hopkinson. *Light and Lighting*, 32. *p.* 64, *March*, 1939.—A large condenser lens was flashed uniformly by light from a projector lamp and in front of the lens was placed a step wedge with a density range of 0 to 3 divided into 20 steps. The contrast between these steps was observed as the brightness of the condenser was varied between 3 and 100,000 e.f.c. As the intensity was increased fewer of the steps were visible, but the contrast between them appeared to remain unchanged. It is concluded that the appreciation of contrast is independent of the brightness range, and that for faithful photographic reproduction of a scene, a contrast of unity is required. W. D. W.

2121. Measurements on Direct and Indirect Adaptation by Binocular Method. J. F. Schouten and L. S. Ornstein. *J.O.S.A.* 29. *pp.* 168–169, *April*, 1939.—Changes in the sensitivity of the fovea of one of the eyes (the right eye) under influence of a glaring source of light shining into that eye can be demonstrated by comparing the visual impression obtained by that eye from a dimly illuminated surface with the impression obtained by the other eye (the left eye) from a similar surface. By adjusting the illumination of one of the surfaces the apparent brightnesses can be made to match exactly. In this way a quantitative method of measuring the sensitivity of the fovea under influence of various conditions of illumination is obtained. When a small area of the retina is illuminated the sensitivity of this area and also of the surroundings drops to a considerably lower level within 0·1 sec. (α-adaptation). The rate of recovery of the sensitivity after exposure is strongly dependent upon the time of exposure (β-adaptation). α-Adaptation can neither be accounted for by assuming a strong adaptive influence of the stray light within the eye, nor by assuming a lateral diffusion of photosensitive substances or of photolytic products over the retina. The hypothesis is put forward that α-adaptation is of electrical origin. This hypothesis accounts for many of the phenomena observed with incandescent lamp light but not for those observed with strongly chromatic light. The only hypothesis presenting itself at present to account for these phenomena seems to be that α-adaptation has its seat in the retinal synapses. AUTHORS.

See also Abstract 2077.

X-RAYS.

2122. General Theory of X-Ray Interference. M. Marue. *Tohoku Univ., Sci. Reports*, 27. *pp.* 410–427, *Jan.*, 1939. *In English.*—Each atom-plane has layer distance and direction; incident X-rays have also wave-length and direction. These combine to cause interference figures. It is clearly explained how the combination affects the interference. The art of reading the figure for studying the nature of a space-lattice, composed by interpenetration of atom-planes, is fully discussed.

2123. Diffusion of X-Rays by Crystals and Microcrystalline Substances. A. Guinier. *Comptes Rendus*, 208. *pp.* 894–896, *March* 20, 1939.—The diffusion of monochromatic X-rays on traversing crystalline material was determined as a function of the direction θ, care being taken to eliminate effects due to fluorescence, etc., so that only the sum of the diffused Compton and coherent radiation was measured. The coefficients of diffusion of diamond, graphite, Al, Cu, Ag and Ni were plotted against sin $\theta/2$ (θ being 0-45°). The curves show no discontinuities: diffusion increases in the neighbourhood of diffraction rays; and does not vanish at very small angles, but after decreasing therewith becomes constant at an angle depending on the substance. This last fact is contrary to theory; it is probably due to diffused coherent radiation and connected with thermal agitation of the atom. **Errata,** *ibid. p.* 1175, *April* 12, 1939. C. A. S.

2124. Influence of Chemical Binding and Crystal Structure on X-Ray Absorption Edges. R. Landshoff. *Phys. Rev.* 55. *pp.* 631–636, *April* 1, 1939.—An attempt is made to explain the positions and the fine structures of X-ray absorption edges, so far as these are not explained by Kronig's theory, by considering that they arise from transitions into a series of discrete states. These are states in which the electron is trapped in the region of surplus positive charge, which is created by the ejection of the electron from the inner shell of the parent ion. To calculate the energy of the trapped states the author uses a model in which the electron is bound to the positive ions in the neighbourhood of the parent ion. AUTHOR.

See also Abstracts 2034, 2250, 2251.

HEAT.

CALORIMETRY.

2125. New Method for Measuring True Specific Heats of Metals at High Temperatures. L. Néel and B. Persoz. *Comptes Rendus*, 208. *pp.* 642–643, *Feb.* 27, 1939.—Temperature losses by conduction and radiation are eliminated by heating a wire of the metal very rapidly (in about 0·1 sec.) using its resistance as an indication of its temperature. R. P.

2126. Specific Heats of Iron between 1·5° and 20° K. G. Duyckaerts. *Comptes Rendus*, 208. *p.* 979, *March* 27, 1939. *Physica*, 6. *pp.* 401–408, *May*, 1939. *In French.*—The specific heat of Fe has been determined over the above temperature range, the results being expressed by the formula $C = 464 \cdot 5(T/465)^3 + 1 \cdot 20 \times 10^{-3}\,T$ cal./gm.atom/° C. The first term is due to the true specific heat of the lattice, the linear term being due to the specific heat of the electrons. A. J. M.

2127. Heat Capacity of Crystalline Tellurium. C. M. Slansky and L. V. Coulter. *Am. Chem. Soc., J.* 61. *p.* 564, *March*, 1939.—The molal heat capacity of Te has been determined from 15 to 300° K., and the entropy at 298·1° K. found to be 11·88 ± 0·10 entropy units. AUTHORS.

2128. Recent Progress in Calorimetry and Thermochemistry. W. A. Roth. *Zeits. f. Elektrochem.* 45. *pp.* 335–343, *April*, 1939.—A general survey of theoretical and experimental work during the last four years. [See Abstract 1187 (1935).]

See also Abstracts 2140, 2148, 2155.

CONDUCTION.

2129. Thermal and Electrical Resistance of Bismuth Single Crystals. Effects of Temperature and Magnetic Fields. G. W. C. Kaye. *Roy. Soc., Proc.* 170*A. pp.* 561–583, *April* 21, 1939.—The thermal and electrical resistivities of Bi single crystals have been studied at a series of temperatures from 25 up to 160° C. In either case, the values for a direction parallel to the trigonal axis are greater than for those at right angles. The temperature coefficient is positive in every case, being roughly twice as large for the electrical resistivity as for the thermal. The effects produced on the resistivities of Bi crystals by magnetic fields up to about 20000 gauss have been measured for various crystal orientations using fields both parallel and at right angles to the thermal or electrical flow. In all circumstances, the resistivity is increased by an amount which is invariably greater (usually substantially) for the electrical resistivity than for the thermal. The effects are most pronounced when the thermal or electrical flow is parallel to the trigonal axis, and the field is at right angles to one of the three " lines" or secondary axes. The effects are least pronounced when the field, the flow and the trigonal axis are all parallel. In all the orientations, the effects are relatively small and approximately parabolic for fields up to about 2000 gauss, thereafter becoming linear and more pronounced for stronger fields, except for one or two orientations where there is a tendency to " saturation." The observations lend support to the view that there are two conducting mechanisms through the medium of which a magnetic field can affect the conductivity, one predominating for electrical conduction while both appear to be operative for thermal conduction, their relative contributions varying with the orientation. [See also Abstract 1911 (1930).] AUTHOR.

2130. Thermal and Electrical Conductivity of Iron at High Temperatures. R. W. Powell. *Phys. Soc., Proc.* 51. *pp.* 407–418, *May*, 1939.—The author's previously published results for the thermal conductivity of Armco iron up to a temperature of 800° C. have been confirmed by two independent methods. The first was a comparative method involving longitudinal heat-flow, and the second an absolute method in which the heat flowed radially from the centre to the circumference of a thick-walled cylinder. By means of the latter method the thermal conductivity has since been determined up to a temperature of just over 1000° C. The thermal conductivity of this sample of iron is found to decrease steadily as the temperature is raised through the magnetic transformation region, and to reach a minimum value of 0·065 cal./cm.-sec.-° C. in the vicinity of the α-γ transformation point. Determinations of the electrical resistivity of the same iron have been extended to a temperature of 1430° C., and the Lorenz function has been evaluated over the range covered by the experiments on thermal conductivity. From 200 to 800° C. this function has unusually high values of $(0{\cdot}72 \pm 0{\cdot}02) \times 10^{-8}$ but above the magnetic transformation point a steady decrease occurs, a value of $0{\cdot}60 \times 10^{-8}$ being reached at 1000° C. The Lorenz function of γ iron is thus seen to be in reasonable agreement with the value of $0{\cdot}58_6 \times 10^{-8}$ indicated by Sommerfeld's theory. [See Abstract 3646 (1936).] AUTHOR.

CONVECTION.

2131. Convection of Heat from a Plane. P. Vernotte. *Comptes Rendus*, 208. *pp.* 976–978, *March* 27, 1939.—The general case of two-dimensional convection of heat from a heated plane by a moving fluid is briefly examined mathematically, and the case of natural free convection is briefly discussed in terms of the results. The coefficient of natural convection is found to be approximately a linear function of $\Theta^{1/6}$ and not, as is customarily assumed, proportional to $\Theta^{1/4}$. [See also Abstract 3894 (1937).] J. S. G. T.

2132. Combination of Hydrodynamic Theory of Heat Transference and Langmuir's Theory. Part II. W. Elenbaas. *Physica*, 6. *pp.* 380–381, *April*, 1939. *In German.*—The Grashof number G is expressed as a function of the Nuszelt number, N. [See Abstract 5021 (1937).] A. J. M.

DILATATION.

***2133. Thermal Expansion of Ni-Cu Alloys at Low Temperatures. Part I. S. Aoyama and T. Itô.** *Tohoku Univ., Sci. Reports*, 27. *pp.* 348–364, *Jan.*, 1939. *Report No.* 452 *of the Research Inst. for Iron, Steel and other Metals. In English.*—With a newly devised dilatometer for low temperatures down to the boiling point of liquid H_2, the thermal expansion and its characters of Ni-Cu alloys were investigated. The anomaly reported by F. Simon and R. Bergmann for Cu and Ni was not observed. The results of measurements for Cu are explained satisfactorily on the basis of Grüneisen's theory. AUTHORS.

See also Abstract 1873.

FUSION AND SOLIDIFICATION.

***2134. Principles of Cryoscopy and the Construction of a Cryoscopic Apparatus. Y. Doucet.** *Comptes Rendus*, 208. *pp.* 577–579, *Feb.* 20, 1939.—The difficulties due to surfusion experienced in cryoscopic measurements are briefly recalled. It is stated that to increase the precision of such measurements surfusion must be avoided, and the measurement of temperature and concentration improved. A cryoscopic apparatus which, it is claimed, fulfils these conditions is described. Full details are given of the construction of the apparatus, and of the range and types of instruments used. S. W.

TEMPERATURE.

2135. Establishment of a Temperature Scale for the Calibration of Thermometers between 14° and 83° K. H. J. Hoge and F. G. Brickwedde. *Bureau of Standards, J. of Research*, 22. *pp.* 351–373, *March*, 1939.—Seven resistance thermometers (six Pt; one 90 Pt : 10 Rh alloy) have been calibrated on the thermodynamic scale by comparison with a He gas thermometer. The boiling point of O_2 was taken to be 90·19° K., and computations were made in such a way as to secure continuity between the International Temperature Scale and the scale being established. On the latter scale the triple point of normal H_2 was found to be 13·96° K. and the boiling point 20·39° K. Tables have been prepared by means of which temperatures corresponding to observed resistances may be obtained by linear interpolation. AUTHORS.

2136. International Temperature Scale and Some Related Physical Constants. H. T. Wensel. *Bureau of Standards, J. of Research,* 22. *pp.* 375–395, *April,* 1939.—The situation in regard to the radiation constants is reviewed primarily for the purpose of selecting the value of c_2 to use in Planck's equation for securing, above 1063° C., a temperature scale which most nearly conforms with the thermodynamic scale. The values in the literature are discussed, and some data are presented for deriving c_2 from gas thermometry data. The constants arrived at are the following: $\sigma = (5{\cdot}70 \pm 0{\cdot}02) \times 10^{-5}$ erg.sec^{-1}.cm^{-2}.deg^{-4}.; $c_1 = (3{\cdot}732 \pm 0{\cdot}006) \times 10^{-5}$ erg.cm^2.sec^{-1}.; $c_2 = 1{\cdot}436 \pm 0{\cdot}001$ cm.deg.; $\lambda_m T = (2892 \pm 2) \times 10^{-4}$ cm.deg.; M = least mechanical equivalent of light $= 0{\cdot}00151 \pm 0{\cdot}00001$ watt ("new" lumen)$^{-1}$. AUTHOR.

2137. Proposed New Definition of Thermodynamic Temperature Scale: with a Parable of Measures to Improve Weights. W. F. Giauque. *Nature,* 143. *pp.* 623–626, *April* 15, 1939.—The author contends that the natural and easiest way to define the size of the degree on the thermodynamic scale and to afford the widest attainment of accuracy is to select *one* easily obtained and accurately fixed point, *e.g.*, a melting point, T_0, and to assign to it a number such that degrees of the desired size are attained. The permanent adoption of the best value of the ice-point for T_0 on the absolute scale would ensure (1) an increased accuracy with which temperatures may be fixed on the thermodynamic scale, (2) elimination of confusion resulting from lack of agreement as to the "best" value of T_0, and (3) no necessity for changes in publishing thermodynamic data. The existing status of the thermodynamic scale is emphasised by a parable of measures taken to establish a convenient standard of weight. J. S. G. T.

2138. Temperature Equilibrium and Temperature Measurements in Flames. H. G. Wolfhard. *Zeits. f. Physik,* 112. 1–2. *pp.* 107–128, 1939.—The absorption and emission of OH and C_2 bands in Bunsen, C_2H_2 + air, $C_2H_2 + O_2$ and $H_2 + O_2$ flames are investigated. The OH bands appear strongly throughout the whole flame and can be used to determine the temperature by the reversal method. The temperatures so found are in agreement with the true flame temperatures. In the inner cone of the Bunsen and C_2H_2 + air flames the OH molecules show anomalously high rotational temperatures of 5000 to 6000° K., and must therefore be strongly affected by the process of decomposition of the hydrocarbons. The C_2 bands are emitted more strongly in the inner cone than would correspond to thermal equilibrium. The rotations show a Maxwell distribution corresponding to a temperature of 5180° K., whereas the true flame temperature is only 3300° K. It is probable that the decomposition of C_2H_2 gives excited C_2 in the inner cone, and that some of these C_2 molecules lose their excitation energy by radiation, while others give it up by collision to other species such as OH. L. A. W.

***2139. Thermoelectric Measurement of High Temperatures in Pressure Apparatus. F. Birch.** *Rev. Sci. Instruments,* 10. *pp.* 137–140, *April,* 1939.—The effect of pressures up to 4000 kg./cm^2. upon the thermal e.m.f. of chromel-alumel, and of Pt-Pt 10% Rh couples has been observed for hot-junction temperatures up to 580° C. Within this range, the e.m.f. of the cormel-alumel couple is independent of the pressure, to within about 10 μV, or 0·25°. An appreciable and regular effect is found for the Pt-Rh couple, amounting to a decrease of the e.m.f. by about 16 μV, or 1·8° C. at 500°, for a pressure of 4000 kg./cm^2. The results are presented as curves showing the decrease of e.m.f. as function of temperature and pressure. AUTHOR.

2140. Measurements on Iron Ammonium Alum. H. B. G. Casimir, W. J. de Haas and D. de Klerk. *K. Onnes Lab. Leiden, Comm. No.* 256*a. Physica,* 6. *pp.* 241–254, *March,* 1939. *In English.*—The measurement of the susceptibility, entropy and specific heat of iron ammonium alum in the region between 0·5 and 4·2° K. is described. [See following Abstract]. H. J. H. S.

2141. New Method for Determining Specific Heats at Extremely Low Temperatures. H. B. G. Casimir, W. J. de Haas and D. de Klerk. *K. Onnes Lab. Leiden, Comm. No.* 256*b. Physica,* 6. *pp.* 255–261, *March,* 1939. *In English.*—The chief difficulty in determining the heat content of paramagnetic salts at very low temperatures is to supply a known quantity of heat. A method of overcoming this difficulty is described; an alternating field is applied to the salt and the energy dissipated is measured by means of a bridge method. In this way an accurately known quantity of heat is applied homogeneously to the spin system itself which thus prevents the lattice from being raised to a higher temperature than that of the spin system. [See preceding and following Abstracts.] H. J. H. S.

2142. Adiabatic Demagnetisation of Chrome Alum. H. B. G. Casimir, W. J. de Haas and D. de Klerk. *K. Onnes Lab. Leiden, Comm. No.* 256*c. Physica,* 6. *pp.* 365–368, *April,* 1939.—It was found that the results of demagnetisation experiments on $KCr(SO_4)_2 \cdot 12H_2O$ can be satisfactorily described by the theoretical formulæ of Hebb and Purcell [see Abstract 2708 (1937)]. It is concluded that for all temperatures above 0·07° K. the relation between T and T* given by theory is reliable to within 0·01° K. The Stark splitting was found to be 0·27° K. [See preceding Abstract.] AUTHORS.

2143. Time Effects in Magnetic Cooling Method. H. N. V. Temperley. *Cambridge Phil. Soc., Proc.* 35. *pp.* 256–264, *April,* 1939.—In consequence of the magnetic and exchange interactions between the ions of a paramagnetic salt, a new mechanism of interaction between ion and lattice is possible, involving the simultaneous transition of two or more ions with the emission or absorption of only one elastic quantum. This new mechanism seems to be capable of removing the discrepancy between theory and experiment for iron alum, and considerably reduces the discrepancy for cæsium titanium alum. AUTHOR.

2144. Heating of Iron Ammonium Alum by Alternating Magnetic Fields at Very Low Temperatures. E. S. Shire and H. M. Barkla. *Cambridge Phil. Soc., Proc.* 35. *pp.* 327–335, *April,* 1939.—The irreversible heating of iron ammonium alum by an alternating field is shown to be proportional to the frequency of the field. The heating is therefore similar to that arising from hysteresis in ferromagnetics, but no remanence could be found by a ballistic method at the lowest temperature obtained, about 0·075° K. The rate of heating was much increased by the superposition of a steady magnetic field of a few hundred gauss. AUTHORS.

See also Abstracts 1963, 2044, 2133, 2141, 2154 and
776B. Temperature-Indicating Paints. F. Penzig.
1052–1067B. Gas Temperature Measurements (Symposium).

THERMOCHEMISTRY.

2145. Heats of Combustion of Tetramethylmethane and 2-Methylbutane. J. W. Knowlton and F. D. Rossini. *Bureau of Standards, J. of Research,* 22. *pp.* 415–424, *April,* 1939.—Measurements of the heats of combustion of gaseous tetramethylmethane (neopentane) and gaseous 2-methylbutane (isopentane) in O_2, at 25° C. and a constant total pressure of 1 atm., to form gaseous CO_2 and liquid water, yielded the following values in int. kj/mole : tetramethylmethane, 3516·53 ± 0·94 ; 2-methylbutane, 3528·03 ± 0·62. Converted to kg.cal. by means of the factor 1/4·1833, these values become, respectively, 840·61 ± 0·23 and 843·36 ± 0·15 kg.cal./mol. Combination of these values with those previously reported for normal pentane shows that, in the gaseous state at 25° C. and 1 atm., the energy content of normal pentane is greater than that of 2-methylbutane by 8·09 ± 1·08 kj, or 1·93 ± 0·26 kg.cal./mol., and greater than that of tetramethylmethane by 19·59 ± 1·29 kj, or 4·68 ± 0·31 kg.cal./mol. AUTHORS.

2146. Heat and Free Energy of Formation of Water and of Carbon Monoxide. F. D. Rossini. *Bureau of Standards, J. of Research,* 22. *pp.* 407–414, *April,* 1939.—Thermodynamic data were combined to yield values for the heats and free energies, per mole, of the following reactions, with each substance in the thermodynamic standard state:

$H_2(g) + 1/2O_2(g) = H_2O(liq.)$, $\Delta H^\circ_{298\cdot16} = -285{,}795 \pm 40$ int. j ($-68{,}318\cdot1 \pm 9\cdot6$ cal.), $\Delta F^\circ_{298\cdot16} = -237{,}163 \pm 47$ int. j ($-56{,}692\cdot8 \pm 11\cdot2$ cal.) ;

$H_2O(liq.) = H_2O(g)$, $\Delta H^\circ_{298\cdot16} = 44{,}007 \pm 13$ int. j ($10{,}519\cdot7 \pm 3\cdot1$ cal.), $\Delta F^\circ_{298\cdot16} = 8597 \pm 4$ int. j ($2055\cdot1 \pm 1\cdot0$ cal.) ;

$H_2(g) + 1/2O_2(g) = H_2O(g)$, $\Delta H^\circ_{298\cdot16} = -241{,}788 \pm 42$ int. j ($-57{,}798\cdot4 \pm 10\cdot0$ cal.), $\Delta F^\circ_{298\cdot16} = -228{,}566 \pm 47$ int. j ($-54{,}637\cdot7 \pm 11\cdot2$ cal.) ;

$CO(g) + 1/2O_2(g) = CO_2(g)$, $\Delta H^\circ_{298\cdot16} = -282{,}942 \pm 120$ int. j ($-67{,}636\cdot1 \pm 28\cdot7$ cal.), $\Delta F^\circ_{298\cdot16} = -257{,}069 \pm 121$ int. j ($-61{,}451\cdot2 \pm 29\cdot0$ cal.) ;

C (c, graphite) + $1/2O_2(g) = CO(g)$, $\Delta H^\circ_{298\cdot16} = -110{,}413 \pm 129$ int. j ($-26{,}393\cdot8 \pm 30\cdot8$ cal.), $\Delta F^\circ_{298\cdot16} = -137{,}158 \pm 133$ int. j ($-32{,}787\cdot0 \pm 31\cdot8$ cal.) ;

$H_2(g) + CO_2(g) = H_2O(g) + CO(g)$, $\Delta H^\circ_{298\cdot16} = 41{,}154 \pm 127$ int. j ($9837\cdot7 \pm 30\cdot4$ cal.), $\Delta F^\circ_{298\cdot16} = 28{,}504 \pm 130$ int. j ($6813\cdot8 \pm 31\cdot1$ cal.) ;

C (c, graphite) + $CO_2(g) = 2CO(g)$, $\Delta H^\circ_{298\cdot16} = 172{,}529 \pm 244$ int. j ($41{,}242\cdot3 \pm 58\cdot4$ cal.), $\Delta F^\circ_{298\cdot16} = 119{,}911 \pm 248$ int. j ($28{,}664\cdot2 \pm 59\cdot3$ cal.). AUTHOR.

2147. Equilibrium $P_4 \rightleftharpoons 2P_2$ in Phosphorus Vapour. G. Wétroff. *Comptes Rendus,* 208. *pp.* 903–905, *March* 20, 1939.—The author corrects the value, − 31·5 kg.cal., obtained by Preuner and Brockmöller (1913) for the heat of dissociation of the molecule P_4 into molecules P_2. The corrected value, − 41 kg.cal., is in good agreement with that previously obtained by Stock, Gibson and Stamm (1912). The heat of dissociation at absolute zero, − 50 ± 4 kg.cal., and the heat of evaporation per gm.atom, − 73 ± 2 kg.cal., are deduced. S. W.

2148. Atomic Heat of Nitrogen in Nitrides. Part II. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 886. *pp.* 385–398, *March,* 1939. *In English.*—With the object of applying Neumann-Kopp's law the atomic heat of N was deduced from the molecular heats of various nitrides which had not been considered in the previous paper [see Abstract 3774 (1938)]. It was found that abnormal decrease of the atomic heat of N appears to be a property common to all nitrides of the elements with small atomic numbers; and that so far as a nitride is concerned, within the limit of the present knowledge, the atomic heat of N may be provisionally estimated to have the value of about 3·5 which is considerably removed from the value 6·2, and to have the values of about 3·1, 3·7, 5·1, and 6·1 at 25° C., 100° C., 300° C., and 500° C. respectively. AUTHOR.

2149. Thermochemistry of Nitrogen Compounds. M. Brutzcus. *Comptes Rendus*, 208. *pp*. 997–999, *March* 27, 1939.—From calorimetric and spectrographic thermochemical data the heats of emission accompanying the following changes are deduced : $V^{\circ} \rightarrow V^{1} = 9 \cdot 2$ kg.cal. ; $V^{\circ} \rightarrow V^{II} = 106 \cdot 9$; $V^{II} \rightarrow V^{IV} = 152 \cdot 7$; $V^{I} \rightarrow V^{III} = 172 \cdot 3$; $V^{III} \rightarrow V^{IV} = 159 \cdot 6$. It is hence inferred that N is pentavalent in HNO_3. Other results arrived at are L_t(N–H) = 143·6 ; the same "intrinsic," 227·8. L_t(C–N) in CN compounds = 167, which shows the C in them to be divalent. It has the same value in nitro-derivatives and anilides. [See Abstract 753 (1939).] C. A. S.

2150. Effect of High Pressures on Propagation of Reactions in Solid Explosives. H. Muraour and J. Basset. *Comptes Rendus*, 208. *pp*. 809–811, *March* 13, 1939.—The explosion of lead azide in N_2 at pressures of 1000, 3000, 5000, 7000, 9000, 10000, and 12000 kg./cm². has been investigated. The size of the hole produced in a metal plate by the explosion of 50 mg. of lead azide was 10 mm. at atmospheric pressure and 4 mm. at 1000 kg./cm². The mechanical effect of the explosion is less at higher pressures and becomes practically zero at pressures greater than 5000 kg./cm². The same effect was observed with diazo-m-nitraniline perchlorate. Dynamite and picric acid burn without detonation under a pressure of N_2 of 10000 kg. per sq. cm. A. J. M.

2151. Explosive Decomposition. T. Urbansky and Rychter. *Comptes Rendus*, 208. *pp*. 900–902, *March* 20, 1939.—If crystals of certain explosive substances are thrown on to a red hot metallic plate they take on the spheroidal state and this delays their inflammation. The substances studied were penthrite, nitroglycerin, nitroergthrite, tolite, and NH_4NO_3. The temperature t_d, at which the maximum delaying effect of the spheroidal state occurs, was determined for the above substances and found to be 490°, 470°, 470°, 530° and 550° respectively. In a still lower temperature range the substances, with the exception of nitroglycerin and nitroerythrite, decompose very violently but without explosion and usually without noise or flame. This is related to the fact that, at these low temperatures, the energy of activation is much higher in the case of these two substances than it is in the case of the others. There seems to be an absence of long chain reactions in explosions of substances in the spheroidal state. G. G.

See also Abstracts 2128, 2138.

THERMODYNAMICS.

2152. Theory of the Liquid State. R. Fürth, L. S. Ornstein and J. M. W. Milatz. *K. Akad. Amsterdam, Proc.* 42. 2. *pp*. 107–117, 1939. *In German.*—A theory of the liquid state, based upon the assumption of the existence of cavities in the liquid is developed. Values of the radii, volumes, and total number of cavities per mol, (s), and the ratio γ of the Loschmidt number per mol. to s are tabulated for 13 elements. The diameter of thecavities is, in general, of the order 1-2 atomic diameters; γ lies between 10 and 100 with a few exceptions. Values of internal pressure are calculated in two different ways for 7 elements*; the results are not concordant and the discrepancy is attributed to a difference between the "ideal" and "actual" tenacity of a solid owing to the effect of surface irregularities. An expression is derived for the viscosity of a liquid and is found to accord well with data relating to the temperature coefficients of the viscosity of Sn, Pb and Hg; data relating to the latent heats of evaporation of these metals are not in agreement with the theoretical results. J. S. G. T.

2153. Joule-Thomson Coefficient of Methane. R. A. Budenholzer, B. H. Sage and W. N. Lacey. *Indust. and Engin. Chem.* **31.** *pp.* 369–374, *March*, 1939.—The Joule-Thomson coefficient for gaseous CH_4 was determined at temperatures from 70° to 220° F. and for pressures from 1 atm. to 1500 lb./in^2. A comparison of volumetric data derived from these measurements with directly measured values has been included. The experimental results have been presented in tabular and graphical form. AUTHORS.

2154. Two-Phase Equilibrium in Binary and Ternary Systems. Part I. CH_4-C_2H_6. M. Ruhemann. *Roy. Soc., Proc.* 171*A*. *pp.* 121–136, *May* 1, 1939.—Thermodynamical formulæ are derived for the equilibrium of a binary liquid with its vapour. An apparatus is described for determining dew and boiling curves of mixtures at low temperatures. Pressure-composition curves of CH_4-C_2H_6 mixtures have been determined at − 104, − 88, − 78, − 42 and 0° C. at pressures up to 100 atm. On the basis of these measurements tenperature-composition curves have been computed for 5, 10, 15 and 20 atm. The critical pressure of CH_4-C_2H_6 mixtures rises between the critical point of CH_4 (− 82° C.) and − 78° C. from 45·8 atm. to well over 100 atm. Up to 15 atm. CH_4-C_2H_6 mixtures show only slight deviations from perfect solutions. AUTHOR.

2155. Partly Unbalanced Processes and the Experiment of Clément and Desormes. M. Masius. *Am. Phys. Teacher*, 7. *pp.* 35–39, *Feb.*, 1939.—The expansions of gases which occur in nature are intermediate between the free expansion into a vacuum and the reversible completely balanced expansions of a Carnot cycle. The present paper considers the relations which hold for such intermediate adiabatic partly balanced expansions, and by way of an illustrative example the results are applied to the Clément and Desormes experiment. It is shown that the normal method of evaluation for experiments of this type, which is based on the assumption of a reversible expansion, gives too small a value for the ratio of the specific heats. The difference, however, appears to be small for the excess pressures normally used. R. W. P.

2156. Entropy of Solution of Hexane with Hexadecane. J. H. Hildebrand and J. W. Sweny. *J. Phys. Chem.* 43. *pp.* 297–300, *March*, 1939.—In the recent symposium on intermolecular action [see Abstract 1731 (1939)] experimental data were presented which indicated that normal hexane and normal hexadecane formed ideal solutions in accordance with an earlier prediction. At the same time mention was made of further experimental verifications which have now been completed and are reported in the present paper. Experimental details are given, a tensimeter described with illustration, and the ratio p/p^0 found to be practically independent of temperature, a further and most direct evidence that the entropy of solution follows Raoult's law. The system used corresponds excellently with the model employed for analysing the possible configurations in a system of linear molecules of different lengths in parallel arrangement. H. H. Ho.

2157. Liquid Structure and Entropy of Vaporisation. J. H. Hildebrand. *J. Chem. Phys.* 7. *pp.* 233–235, *April,* 1939.—The entropies of vaporisation of a number of liquids to the same vapour volume are compared and show evidence that more or less ordered arrangements in liquids can result not only from (*a*) chemical bonds, and (*b*) dipole orientation but also from (*c*) geometrical form. This last, *i.e.* (*c*), alone may suffice to cause significant departures from the entropy of forming a regular solution. AUTHOR.

2158. Symmetry Number and Thermodynamic Functions for Molecules Having Double Minimum Vibrations. K. S. Pitzer. *J. Chem. Phys.* 7. *pp.* 251–255, *April,* 1939.—The energy levels and thermodynamic functions for a double minimum vibrational degree of freedom are presented, and their application illustrated for the case of ammonia. A simple formula is given for the range of validity of the classical expressions for rotational heat capacity and entropy. Also the symmetry number, which is troublesome in examples of double minimum vibration. is discussed briefly. [See Abstract 3190 (1937).] AUTHOR.

2159. Thermodynamics of Reversible Hydrogenation Processes. G. Holst. *Zeits. f. phys. Chem.* 183. *Abt.A.* 6. *pp.* 423–437, 1939.—The approximately constant value of -7×10^{-4} V/° C. which has been obtained from measurements on aqueous solutions for the Redox potential for equilibria of the type $A + H_2 \sim AH_2$ is shown to be calculable from the Nernst formula. R. W. P.

VAPORISATION AND CONDENSATION.

2160. Saturation Pressure of Steam Between 73° and 130° C. H. Moser and A. Zmaczynski. *Phys. Zeits.* 40. *pp.* 221–229, *April* 1, 1939. *From the Reichsanstalt.*—The saturation pressure p of steam has been determined over the range 73°–130° C. by two radically different methods, namely a static method (using a glass membrane manometer) and a dynamic (ebulliometric) method due to Swietoslawksi. The difference between the values obtained by the two methods is on the average 0·0011. The following equations were calculated from the results by the method of least squares :—

$$p - 760 = 27{\cdot}12912\ (t - 100) + 0{\cdot}400793\ (t - 100)^2 + 3{\cdot}04131 \times 10^{-3}\ (t - 100)^3 + 1{\cdot}1241 \times 10^{-5}\ t(-100)^4.$$

$$t - 100 = 3{\cdot}68608 \times 10^{-2}\ (p - 760) - 2{\cdot}0073 \times 10^{-5}\ (p - 760)^2 + 1{\cdot}625 \times 10^{-8}\ (p - 760)^3 - 1{\cdot}61 \times 10^{-11}\ (p - 760)^4.$$

between 680 and 800 mm. Hg. E. H. D.

2161. Volatilisation of Metallic Compounds from Solutions in $HClO_4$ or H_2SO_4. J. I. Hoffman and G. E. F. Lundell. *Bureau of Standards, J. of Research,* 22. *pp.* 465–470, *April,* 1939.—Distillation from $HClO_4$ or H_2SO_4 solutions, during the gradual addition of HCl or HBr to the hot solution (200° to 220° C.), was undertaken to obtain information on the volatility under these conditions of elements that might be encountered in chemical analysis. It was found that, if proper conditions are established, Sb, As, Cr, Ge, Os, Re, Ru and Sn can be quantitatively distilled from $HClO_4$, and Ge, As, Se, Sn, Sb and Re from H_2SO_4 solutions. Certain others, as Bi, B, Au, Mo, Te and Tl may be lost in part from either $HClO_4$ or H_2SO_4 solutions. From the information obtained, certain precautions against unintentional losses are evident, and certain possible separations of elements are indicated. AUTHORS.

V.4
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2162. Formation of Condensation Nuclei under the Influence of Electric Charges. T. Glosios. *Ann. d. Physik,* 34. 5. *pp.* 446–448, *March,* 1939.—It is shown that the theory of Tohmfor and Volmer [see Abstract 5003 (1938)] with certain refinements is in agreement with experiment without supposing that there is a decrease in the dielectric constant of a liquid in the form of drops. A. J. M.

2163. Activity Coefficients of NH_4Cl in Liquid NH_3. H. W. Ritchey and H. Hunt. *J. Phys. Chem.* 43. *pp.* 407–416, *April,* 1939.—The vapour pressure difference between NH_4Cl solutions in liquid HN_3 and pure liquid NH_3 has been determined for solutions ranging from 0·0051 molal to 0·900 molal. Activity coefficients for NH_4Cl in liquid NH_3 at various molalities have been calculated from the vapour pressure data, using the method of Randall and White. The Debye-Hückel theory as applied thereto has been tested and found to hold only at very low molalities. Standard electrode potentials have been calculated from the free energies of formation, the potential measurements of Yost and co-workers, and the authors' measured values of activity coefficients. AUTHORS.

See also Abstracts 1898, 1963, 2088.

ACOUSTICS.

2164. Mechanical and Electrical Analogies of the Acoustical Path. H. L. Saxton. *Acoustical Soc. of America, J.* 10. *pp.* 318–323, *April,* 1939.—The infinite acoustical path is treated as a smooth mechanical transmission line, using Firestone's method [see Abstract 2613B (1938)] of drawing schematic diagrams. The method is adopted of translating thermodynamical, hydrodynamical and collision processes into purely mechanical terms by solving for the circuit elements from their definitions. When representative *T* sections have been obtained for paths having successive single causes of sound absorption, these are compounded into a *T* section for the case where all these causes of absorption are present. The electrical analogy follows at once from the mechanical. Input mobilities and complex velocities for the several cases are derived. AUTHOR.

2165. Excitation of Chladni Figures. L. Sibaiya. *Indian Journ. Phys.* 12. *pp.* 407–408, *Dec.,* 1938.—The method adopted for exciting a centrally fixed plate at any given point not necessarily on the periphery was as follows :—A brass rod was clamped firmly at its mid-point and placed vertically with one of its sharpened ends resting lightly on the plate at the given point. Stroking the rod with a cloth dusted with powdered resin caused the rod to vibrate longitudinally and the plate to be excited in one of the natural frequencies corresponding to the point of excitation and not at the natural frequency of the rod, which is actually executing a forced oscillation and thus serving mainly as a conveyor of energy to the plate. Excitation of the plate is, of course, more vigorous if the frequency of the rod is brought near to the plate frequency desired either by adjustment of the rod length or by suitable loading. Tinsel powder was found very suitable for obtaining photographs of the Chladni figures obtained. Photographs are given of patterns thus obtained with a square and with a round plate, both centrally fixed, and also of the vibration patterns of the belly of an Indian musical intrument, the vina, which somewhat resembles a guitar. A. W.

2166 Velocity of Sound in Air. W. H. Pielemeier. *Acoustical Soc. of America, J.* 10. *pp.* 313–314, *April,* 1939.—Determination by capable investigators of the velocity of sound in dry air at 0° C. range from 330·6 to 331·9 m./sec. Miller's value (331·36 ± 0·08) m./sec. is probably the best for low frequency (explosive) sounds. Part of this range of values may be due to dispersion. The CO_2 and O_2 contents of air are sensitive to water vapour in this respect. The dispersion in air manifests itself as a small excess over the velocity values calculated for given humidities and temperatures by means of Miller's classical formula. These calculated values of V for a given temperature are approximately a linear function of the vapour pressure. These and the observed values are plotted. Other curves show how the dispersion frequencies in CO_2 and O_2 depend on the humidity. The "observed" value of V_0, the velocity of sound in dry air at 0° C., calculated from *measurements* at a given frequency and humidity by Miller's formula depends somewhat on these existing conditions. AUTHOR.

2167. True Velocity of Sound in Air. H. O. Kneser. *Ann. d. Physik,* 34. 7. *pp.* 665–668, *April,* 1939.—Accurate knowledge of the velocity of sound in air is necessary for many problems of applied acoustics and particularly in the cases of relative velocity measurements where air is used as the comparison substance. The results of measurements of the velocity of sound in air, using single impulses and low and high frequencies, by Colwell, Friend and McGraw, Kukkamäki, Ladenburg and von Angerer, Hebb, Gruneisen and Merkel, Grabau, Pierce and Kao, are plotted and discussed. Reasons are given for the relatively low values of the velocity obtained by the single impulse method. It is concluded that a reliable value for the velocity of sound in air at 0° C., the air being dry and free from CO_2, is 331·60 ± 0·05 m./s. Below 300 $\sim$ the velocity will be slightly less, owing to dispersion by oxygen, and should be 331·47 m./s. In moist air this value should be used for frequencies up to about 3000 $\sim$. A. W.

2168. Probability of Transference of Vibrational Energy during Collision of CO_2 Molecules with other Molecules. I. M. Metter. *Acta Physicochimica,* 9. 6. *pp.* 845–860, 1938. *In German.*—With the aid of an ultra-acoustic interferometer of special construction, an investigation was made of the dispersion of supersonic waves in CO_2 to which had been added in turn H_2O, NO, CO and N_2. For given additions of the admixture points on the dispersion curve were obtained, and the asymptotic values of the velocity of sound in the gas mixtures were calculated. The probabilities of the transference of vibrational energy from the CO_2 molecule on collision with a molecule of the added gas were calculated according to the formulæ of Kneser and Eucken-Becker. The different probabilities are explained as due primarily to the dipole moment of the molecule of the added gas. G. E. A.

2169. Absorption of Supersonic Waves in Human Tissues and its Variation with Frequency. R. Pohlman. *Phys. Zeits.* 40. *pp.* 159–161, *March* 1, 1939.—Measurements were made of the absorption of supersonic waves of frequency 800 and 2400 kc./sec. by muscular and fatty tissue immersed in physiological salt solution. The absorption coefficient was found to be about twice as great for muscular as for fatty tissue. The coefficient increased with frequency less rapidly than in the case of homogeneous fluids having about the same absorption. W. S. S.

2170. Mechanism of Hearing by Electrical Stimulation. S. S. Stevens and R. C. Jones. *Acoustical Soc. of America, J.* 10. *pp.* 261–269, *April,* 1939.—The harmonic components in the complex tone heard when a sinusoidal electric current is passed through the head were measured by the method of " best beats." The relative intensity of these components was determined with and without a polarising d.c. simultaneously applied. With no d.c. the observer hears only the second harmonic of the stimulating frequency, but in the presence of a d.c. he hears the fundamental as well. The quantitative relations between the perceived harmonic components and the polarising current demonstrate that the response of the ear to electrical stimulation follows a square law. On the assumption that the eardrum is moved by electrostatic pressure whenever there is a p.d. between the eardrum and the inner surface of the middle ear, it is possible to account for the square-law response, and for certain other aspects of the electrophonic effect. The middle ear appears, therefore, to behave as a condenser receiver. The large amount of distortion which normally prevents an observer from understanding a radio broadcast when the electrical output of a radio receiver is passed directly through his head can be reduced by the application of a polarising d.c. Under this condition speech and music can be heard with great clarity. [See Abstract 1308 (1937).] AUTHOR.

2171. Reversed Speech. E. W. Kellogg. *Acoustical Soc. of America, J.* 10. *pp.* 324–326, *April,* 1939.—Recording sound and then reproducing it with the rotation of the record reversed is not only a means of amusement, but serves to throw some light on our habits of speech, particularly if one tries reversing the order of the original pronunciation, so that the reproduced sound may be actual words. Some of the writer's observations are given in the paper. AUTHORS.

***2172. The Multitone. W. L. Barrow.** *Acoustical Soc. of America, J.* 10. *pp.* 275–279, *April,* 1939.—A new sound source, which has been termed a " multitone," for space-acoustic measurements is described. It provides a plurality of equi-amplitude tones spaced equally in frequency over a given frequency band. A generator for it is described that employs shock excitation and has no valves. Disc recordings are provided to secure a series of multitones of different mean frequencies but of constant ratio of band width to mean frequency. AUTHOR.

2173. Electroacoustics. *Phys. Soc., Proc.* 51. *pp.* 359–375, *March,* 1939.—A report of a Discussion.

C. V. Drysdale [*pp.* 359–365], in an opening contribution, confined his remarks to some fundamental points. When electric waves pass through a material dielectric, the transverse vibrations of the protons and electrons may produce acoustic waves transverse to the electric waves. The basic requirements of a broadcasting receiver are stated. By means of an acoustic analogy the velocity of electric waves is derived in a simple manner. Other matters treated are acoustic measurements, standard source of sound, sound absorption and noise reduction. An absorbing medium should have a large number of resonant frequencies evenly spaced and a certain amount of internal friction.

W. West (*p.* 365) stated that subjective testing is likely to remain of basic importance to progress in electroacoustics.

G. C. Marris (*pp.* 365–368) pointed out some of the difficulties in the way of progress with loud-speakers.

P. Kerridge (*pp.* 368–369). Electroacoustics in the form of hearing aids and audiometers has already invaded otology.

S. Hill (*p.* 369). Many acoustic problems remain which are the more awkward because they are partly aesthetic.

L. E. C. Hughes (*pp.* 369–370) gave the results of 6 years' experience of the Apparatus Approval Sub-Committee of the Central Council for School Broadcasting. There is no correlation between the objective tests and the subjective rating.

L. C. Pocock (*pp.* 370–371). The link which unites an electrical to a mechanical or acoustic system is a transfer impedance (force factor) which in certain cases resembles an electrical transformer. Refers to the use of the principle in a recent improvement of the telephone receiver.

H. A. M. Clark (*pp.* 371–372) explained the principle of a device used in recording the results of electroacoustic calibrations.

J. McLaren (*pp.* 372–373) gave particulars of the absorptive properties of building materials, as reactive and resistive absorbents.

R. A. Bull (*pp.* 373–374) pointed out that the objective noise meter cannot, with a single calibration, be used for the universal measurement of equivalent loudness.

A. H. Davis (*pp.* 374–375) referred shortly to two recent electroacoustic instruments used in measurements of noise, one an analyser which records the changing constitution of sounds, the other the development of a meter to measure repeated impulsive sounds. G. E. A.

See also Abstract
1273B. Acoustic Resistances. W. Wisotsky.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2174. Auxiliary Equation for Use with Heaviside Expansion Theorem. W. B. Coulthard. *Phil. Mag.* 27. *pp.* 404–406, *April*, 1939.

2175. Approximation Formulæ for Well-Known Difference of Products of Two Cylinder Functions. H. Buchholz. *Phil. Mag.* 27. *pp.* 407–420, *April*, 1939.

2176. Phase Relations in an Inductance Demonstrated at Low Frequencies. G. E. Feiker and W. B. Wadsworth. *Am. Phys. Teacher*, 7. *pp.* 60–62, *Feb.*, 1939.—Describes a circuit employing a l.f. generator (0·2 ∼) by means of which ordinary table galvanometers can be made to show visually the traces of alternating voltages and currents in an inductive circuit. S. A. S.

See also Abstracts
1036B. All-Wave Frequency Meter. A. Habermann.
1037B. Ultra-H.F. Measuring Assembly. S. Sabaroff.

CONDUCTION AND DISCHARGE IN GASES.

2177. Onset of Positive Point-to-Plane Corona in Air at Atmospheric Pressure. A. F. Kip. *Phys. Rev.* 55. *pp.* 549–556, *March* 15, 1939.—Continued investigations [see Abstract 4191 (1938)] with special reference to pre-onset regions are reported. Two kinds of current pulses, shown by oscillographic and photographic studies, and occurring below onset voltages are described. At voltages approaching corona onset, streamers which extend far out into the gap are observed. The steady corona process is normally initiated by one of these streamers. The mechanism for both bursts and streamers is shown to involve space-charge intensification of the field. Streamer propagation and stable burst corona both depend on photoelectric ionisation in the gas. Streamer length is found to depend primarily on point size, and for very fine points no distinction can be made between bursts and streamers. The number of ions produced was found to be approximately 5×10^9 per cm. of visible streamer, and about 2×10^9 in an average burst pulse. The time necessary for positive ions produced by a streamer to cross the gap was found to be of the order 10^{-3} sec., and to vary with gap geometry. N. M. B.

2178. High Pressure Arcs in Common Gases in Free Convection. C. G. Suits. *Phys. Rev.* 55. *pp.* 561–567, *March* 15, 1939.—An oscillographic method is described for measuring the electric gradient E (volts cm^{-1}.), current density I (A cm^{-2}.), total voltage e (volts) as a function of current i in the discharge. The method is applied to arcs in the 0–10-A range under conditions of free convection in N_2, A, and He in the 1–50-atm. pressure range, and to air, CO_2, and steam at atmospheric pressure. The exponent n and B in $E = Bi^{-n}$ are determined for these cases. The range of n is $0{\cdot}54 < n < 0{\cdot}73$, and some dependence on pressure is observed. The exponent m in $E = B_0p^m$ is measured for N_2, H_2, He, and A, and is found to be 0·31, 0·32, 0·20, and 0·16, respectively, with some dependence on current. The method is applied to arcs between electrodes of a number of common metals in air. AUTHOR.

2179. Starting Characteristic of the Townsend Discharge in Inert Gases. H. Büttner. *Zeits. f. Physik*, 111. 11–12. *pp.* 750–769, 1939.—The characteristic of the Townsend discharge in pure inert gases is, as shown by Schade, a falling straight line. In order to ascertain the dependence of the inclination of the starting characteristic (K_1) on the pressure and electrode distance measurements were made in the pressure region of 1 to 20 atm. K_1 in pure inert gases in discharges with constant pd was found to be inversely proportional to the pressure. Holm's similarity rule therefore does not hold for the characteristic. At constant pressure K_1 increases more strongly than linearly with the distance apart of the electrodes. At constant electrode distance K_1 increases approximately proportionally to the pressure. K_1 is greater in dense gases than in light gases. Measurements in mixtures which show the Penning effect indicate that substantial deviations from Paschen's law occur and K_1 greatly depends on the proportion of the mixture. In mixtures with small amount of one constituent the reciprocal inclination ($1/K_1$) is a linear function of the proportion of the mixture. The explanation of these experimental results may be based on Townsend's theory as extended by Schade. J. J. S.

2180. Spontaneous Electron Emission at Electrodes as After-Effect of Gas Discharges. H. Paetow. *Zeits. f. Physik*, 111. 11–12. *pp.* 770–790, 1939.—The electrodes of any discharge tube send out, as after-effect of foregoing discharges, temporary electron currents which soon fade away. These on account of their smallness are only noticed by means of the delayed priming effect. The magnitude of this after current increases in proportion to the product of the duration and current strength of the previous discharge till a saturation value is attained. The emission has its origin in surface accumulations of the electrodes and is excited by the short-wave photons of the discharge. For this excitation of the effect the photons must have a certain minimum energy according to the nature and composition of the substances on the surface. The after current may by suitable preparation of the electrodes pass over into the already known phenomenon of field electron emission at thin insulating layers. Far-reaching agreement and comparison of the phenomena leads to the conclusion that the spontaneous electron emission after gas discharges, as well as the characteristic excitation of counting-tubes, consists of a field emission from residual insulating surface accumulations. It also appears that the field emission at the kathode of the so-called spirting discharge is excited by photons and not, as hitherto assumed, by ions. J. J. S.

2181. Striking Voltage in Pure Mercury Vapour. R. Grigorovici. *Zeits. f. Physik*, 111. 9–10. *pp.* 596–616, 1939.—Using electrodes of Pt, Fe, Al, and Hg, the striking voltage curves for a discharge in Hg vapour between equal and parallel plane electrodes have been investigated with reference to their dependence on the material of the kathode. The results obtained are discussed in relation to the processes occurring in the gas, such as the formation of negative ions and the energy transfer and ionisation by electronic collision, and also to the processes occurring at the kathode, when the mechanism of the release of electrons by the impact of positive Hg ions is considered. It is shown that the formation of negative ions is of secondary importance in the discharge striking process; the energy transfer by electron collision is small and the Townsend ionisation coefficient in Hg vapour is relatively high. It is further suggested that the mechanism of electron release by means of Hg ions is a predominantly thermal effect. Experiments were carried out on the effect of a thin layer of Hg on the kathode and the curves given show an almost constant value for the striking voltage under these circumstances. J. E. R.

2182. Normal and Sub-Normal Relations and Distributions of the Glow Discharge at Plane Semi-Conducting Electrodes of Heated Glass. K. Wolf. *Zeits. f. Physik*, 112. 1–2. *pp.* 96–106, 1939.—The normal kathode fall at heated glass has been determined in air to be 310 V and in H_2 260 V. The influence of the variable specific resistance of glass with temperature on the extreme conditions prevailing in the glow discharge has also been investigated. With increasing glass resistance, the normal current density at glass kathodes decreases, whereas the related potential increases somewhat. When the potential decrease at the glass is too high, a partial unstable kathode covering is formed, and takes the form of rosettes or other figures. When the plane glass electrode is employed as anode, while an iron disc serves as kathode, the beautiful stable figures are formed on the anode, while the glimmer breaks up at the kathode into many round patches. The paper contains full experimental details illustrated by 11 diagrams and pictures. H. H. Ho.

2183. Spray Discharge and Poor Conducting Layers formed on Heated Glass during Discharge. K. Wolf. *Zeits. f. Physik*, 112. 3–4. *pp.* 148–158, 1939.—Heated plane glass kathodes have been formed by the glow discharge in air, H_2 and Hg vapour, and the poor conducting surface layer on the glass has been investigated. At sufficiently low temperatures (= feeble electrolytic conductivity) a beautiful spray discharge may be produced at layers of several μ in thickness, which has been studied in dependence upon thickness, temperature and current strength. With increasing thickness, decreasing temperature or increasing current strength, the usual glow discharge passes over continuously into the spray discharge whereby the Hittorf dark space gradually shrinks and the colour of the glow light in air and hydrogen gradually turns to red (bright red to reddish-fawn). The field strength necessary for the spray discharge is of dimensions 5×10^6 V/cm. The influence of volume discharge within the layer has been determined. Although the spray discharge at low pressures appears to be perfectly quiet and homogeneous, there arise however in the layer countless (up to 10000/mm^2. and more) small perforations ; in the initial stage of the spray discharge these perforations may not be observed perhaps because of their minuteness. At not too thin layers, however, a spray discharge occurs when they are used as anodes whereby the surface is covered with Na. H. H. Ho.

2184. Mass-Spectrographic Investigation of Canal Rays of Hydrogen and Helium. J. W. Hiby. *Ann. d. Physik,* 34. 5. *pp.* 473–487, *March,* 1939.—Using J. J. Thomson's parabola method, several ions are investigated. Observation of the intensity of the line due to H_3^+ under different experimental conditions leads to the conclusion that this ion is unstable against collisions. The mean length of path for the similar D_3^+-ion in D_2 at 10 mm.Hg is found to be 8 cm. If all charged particles are removed from the beam at one point by a local transverse electric field, the D_3^+-line completely disappears, while experiments in H_2 are not conclusive on account of a weak line apparently due to HD^+. This goes to show that the H_3-molecule (whose ground state certainly is unstable) does not occur at all in a canal ray. According to Döpel this is to be expected even if short-lived excited states of this molecule exist otherwise. Likewise there was no trace of HeD-or HeH-molecules. A very weak line due to the negative He-ion is found but no trace of a H_2^--ion. L. E. F.

2185. Combination of N_2 and O_2 in Glow Discharge. W. Holtz and R. Müller. *Ann. d. Physik,* 34. 6. *pp.* 489–520, *March,* 1939.—The glow-discharge spectra of mixtures of N_2 and O_2 are photographed and compared with the corresponding spectra for pure N_2, O_2 and the oxides of nitrogen. Investigations with mixtures of N_2 and O_2 at rest show the presence of NO-β-bands in the spectra. The origin of the bands is the negative glow, no evidence of compound formation in the positive column being obtained. The only effect of excess O_2 is to repress the intensity of emission. Similar results are obtained with flowing mixtures of N_2 and O_2, NO-β-bands and NO_2-bands being observed in the negative glow when N_2 is in excess. Exploration shows that the maximum combination takes place at the limit of the negative glow. The collisional processes and reaction mechanism are discussed and a scheme is put forward to explain the observed phenomena. L. A. W.

See also Abstracts 1863, 1899, 2039, 2040, 2051, 2089, 2114, 2115, 2116, 2162 and 1003B. Arc Ignition Device. J. van Calker.

CONDUCTION IN SOLIDS AND LIQUIDS.

2186. Energy States of Valency Electrons in Metals. M. Satô. *Tohoku Univ., Sci. Reports,* 27. *pp.* 278–325, *Jan.,* 1939. *Report No.* 450 *of the Research Inst. for Iron, Steel and other Metals. In English.*—The experimental evidence concerning anomalous changes in various properties of zinc with temperature, in the solid and liquid states, is studied, and it is found that there exist eleven anomalies and that they can be classified into four groups. [See also Abstract 3723 (1937).]

2187. Current in the Bloch Approximation of "Tight Binding" for Metallic Electrons. J. Bardeen and J. H. van Vleck. *Nat. Acad. Sci., Proc.* 25. *pp.* 82–86, *Feb.*, 1939.—In Bloch's theory, the wave functions of metallic electrons are approximated by linear combinations of atomic wave functions. It is shown that, when applied to the approximate wave functions, Bloch's method for determining the electron current gives a result which differs from that obtained by the standard method. If H-like atomic wave functions are used, the discrepancy corresponds to a factor of 3. The form of atomic wave function giving agreement is determined. W. S. S.

2188. Method of Reducing Effect of Disturbances in Galvanometer Branch of a Potentiometer Circuit. F. Wenner. *Bureau of Standards, J. of Research*, 22. *pp.* 425–430, *April*, 1939.—The method described automatically eliminates the effect of a thermo e.m.f. in the galvanometer branch and doubles the sensitivity of the galvanometer to a lack of balance of the potentiometer, thus reducing to half the effect of various types of electrical and mechanical disturbances. AUTHOR.

***2189. Potentiometer for Measuring Voltages of 10 μV to an Accuracy of 0·01 μV. R. P. Teele and S. Schuhmann.** *Bureau of Standards, J. of Research*, 22. *pp.* 431–439, *April*, 1939.—In connection with the development of a physical photometer it was found necessary to measure voltages of the magnitude of 10 μV to an accuracy of 1 part in a thousand. The design and construction of a potentiometer of the desired range and accuracy are described. AUTHORS.

2190. Absolute Determination of Electrical Units. R. D. Richtmeyer and W. W. Hansen. *Am. Phys. Teacher*, 7. *pp.* 52–57, *Feb.*, 1939.—The authors describe simple methods, of accuracy about 0·25%, for absolute determinations of current, resistance, and *c* suitable for student's use. Current is determined by weighing the force between parallel wires carrying the current, two symmetrical systems, each consisting of a single moving wire and four fixed wires being employed. Resistance is determined in terms of mutual inductance and frequency, by balancing the secondary p.d. of a mutual inductor against the p.d. across a resister which is in series with the primary of the inductor. As indicator of balance, either an electrometer or a differential thermionic voltmeter is employed. The ratio of units *c* is obtained by comparing the calculated capacitance in e.s.u. of a flat plate condenser made from silvered sheets of plate glass, with the value in e.m.u. obtained by an a.c. bridge method. L. H.

2191. Thermal Evolution and Conductive Power of Thin Layers of Ni. A. Colombani. *Comptes Rendus*, 208. *pp.* 795–797, *March* 13, 1939.—Experimental work is detailed in connection with the production of stable layers of Ni obtained at normal temperature by kathodic pulverisation in H_2. The technique employed is superior to that of Féry for obtaining Pt layers. Isothermal observations were made at intervals of 10° C. up to 400° C. Up to 360° C. the evolutions are progressive and non-reversible for given cases. At 320° C. the isothermals become horizontal and the phase change of evolutions from 320° to 360° C. are comparable with many phenomena noticed with ordinary Ni where most of the characteristics are greatly modified between these temperatures—specific heat, conductivity, etc. E. H. W. B.

2192. Effect of Cooling and of Magnetic Fields on Crystal Rectification. M. A. El Sherbini and Y. L. Yousef. *Phys. Soc., Proc.* 51. *pp.* 449–455, *May*, 1939.—The effect of temperature on rectification has been studied in the case of six different crystals. The effect of temperature variations on crystal rectification in the interval − 75 to + 30° C. is especially interesting in the cases of silicium and molybdenite. In the former case there is a very marked increase in rectification at the higher temperature, and in the latter case the sign of the rectification is changed. The presence of a magnetic field appears to have no effect on rectification. Authors.

2193. Theory of Crystal Rectifiers. N. F. Mott. *Roy. Soc., Proc.* 171*A*. *pp.* 27–38, *May* 1, 1939.—The existing theories of the action of crystal rectifiers assume that between the semiconductor and the metal there is a potential barrier which the electrons penetrate by the tunnel effect. It is shown that this theory gives rectification in the opposite direction to that observed. An alternative theory is proposed; the nature of the potential barrier is discussed and it is assumed that electrons have to be thermally excited so that they go over the barrier, instead of through it. Good agreement with experiment is observed. Author.

2194. Electrical Resistance of Ni Amalgams. L. F. Bates and J. H. Prentice. *Phys. Soc., Proc.* 51. *pp.* 419–424, *May*, 1939.—The electrical resistances of a series of Ni amalgams with concentrations between 0·013 and 0·246 gm. of Ni per 100 gm. of Hg were measured over the temperature range 20 to 300° C. A very marked permanent change in resistance was found to commence at about 225° C. This coincided with a change in the magnetic properties, for at low temperatures the amalgams are diamagnetic with no trace of ferromagnetism, whereas when once 225° C. has been exceeded, they exhibit pronounced and permanent ferromagnetic properties. It is suggested that, since the ferromagnetic metal in Fe or Co amalgams can be concentrated and removed by the application of a magnetic field, the behaviour of Ni amalgams may provide a method for the quantitative estimation of Co in mixed solutions of Co and Ni salts. Authors.

2195. Extrapolation of Conductance Data for Monovalent Nitrates and Iodates. A. R. Gordon. *J. Chem. Phys.* 7. *pp.* 221–222, *April*, 1939.—It is shown that the extended Onsager-Shedlovsky equation $\Lambda_0 = \Lambda_0' - BC - DC \log C$ where Λ and Λ_0 are the equivalent conductances at concentration C and at infinite dilution, Λ_0' is the limiting Onsager function $(\Lambda + \beta C^{\frac{1}{2}})/(1 - \alpha C^{\frac{1}{2}})$, and B and D are disposable constants, serves for the extrapolation of conductance data for the monovalent nitrates and iodates. The anomalies in the conductance at low concentrations of these salts are due to the fact that the logarithmic term is for them relatively more important than it is for the corresponding chlorides. Author.

2196. Variable Semiconductors. Part I. G. Déchêne. *J. de Physique et le Radium*, 10. *pp.* 124–133, *March*, 1939.—With the aid of a kathode-ray oscillograph the mode of establishment of a continuous current in a semiconductor has been investigated. [See Abstract 651 (1938).] W. R. A.

2197. Electrical Phenomena in Palladium with Occluded Hydrogen. K. Hirota and J. Horiuti. *Imp. Acad. Tokyo, Proc.* 15. *pp.* 10–12, *Jan.*, 1939. *In English.*—The apparatus consists of a thin (8μ) Pd wire 1 cm. long sealed in an 8 cm^3. glass cell incorporated in a

Wheatstone bridge and thermostated at 100° C. After 36 days' evacuation a constant resistance of 11·35 Ω, rising to 25·77 Ω, was attained; on admitting H_2 in stages of 10^{-3} mm. Hg the former trend was reversed. After allowing the bridge to balance with a steady current of 2×10^{-4} A, a deflection was observed on closing the circuit, of equal amount and opposite sign, gradually filling to the original steady current. It is suggested that the observations can be explained by assuming the presence of mobile "metal" protons, which, when shielded by electron clouds retain more or less effective changes. D. R. H.

See also Abstracts 1877, 1878, 1881, 1954, 2129, 2130, 2205, 2246.

DIELECTRICS AND CAPACITANCE.

2198. Vapour-Phase Dipole Moments of Thionyl Chloride, Sulphuryl Chloride, Dimethyl Sulphone and Thiophosgene. I. E. Coop and L. E. Sutton. *Faraday Soc., Trans.* 35. *pp.* 505–511, *April,* 1939.—The electric dipole moments of thionyl chloride, sulphuryl chloride, dimethyl sulphone, and thiophosgene were investigated in the gas phase and found to be 1·44 ± 0·005 D, 1·795 ± 0·005 D., 4·44 ± 0·1 D, and 0·28 ± 0·02 D, respectively. The atom polarisations of the first two substances were also evaluated and were found to be 3–4 c.c. for thionyl chloride, and 4·1–5·7 c.c. for sulphuryl chloride, *i.e.*, 13·5–20% and 19–27% of the respective electron polarisations. These are considerably less than values obtained from solution measurements at two temperatures. The cause of the discrepancy is not entirely clear. Comparison of the moments of thionyl chloride with that of dimethyl sulphone provides no support for the idea that the first two molecules are resonance hybrids similar to phosgene. The moment of thiophosgene is smaller than that of phosgene, although other thioketo-compounds have larger moments than the corresponding keto-compounds. Various reasons for this are considered but no final conclusion is reached. AUTHORS.

2199. Influence of Field Strength and Frequency on Dielectric Constant of Strong Electrolytes. F. Frölich. *Phys. Zeits.* 40. *pp.* 124–140, *Feb.* 15, 1939.—The dielectric constant of strong electrolytes is studied when the applied field strength and frequency are varied. The influence of such factors as concentration, dielectric constant of the solvent, temperature and valency, is also investigated. The results are considered in the light of existing theories accounting for the behaviour of electrolytes, in particular the Debye-Falkenhagen theory of inter-ionic attraction and the Wien effect at high field strengths. E. R.

2200. Dielectric Constants of Conducting Solutions. H. M. Grubb and H. Hunt. *Am. Chem. Soc., J.* 61. *pp.* 565–569, *March,* 1939.—The dielectric constants of dilute aqueous solutions of KCl, K_2SO_4 and $MgSO_4$ have been measured at 25° by the grid-dip method using a frequency of about 80 Mc./sec. A new theory has been evolved which accounts satisfactorily for the results found and explains the large discrepancies in the work of several investigators. In three cases quantitative comparisons have been made. AUTHORS.

2201. Dielectric Behaviour of Zein Solutions. M. A. Elliott and J. W. Williams. *Am. Chem. Soc., J.* 61. *pp.* 718–725, *March,* 1939. —A combination of the Debye dipole theory and the Perrin study of the hydrodynamics of an ellipsoid of revolution is applied to experimental data involving the protein zein in aqueous alcoholic solution. A resonance apparatus for making precision dielectric constant measurements with conducting solutions in the frequency range of 1·5 to 40 Mc./sec. is described briefly. The principal feature of the method is the high accuracy of relative values at different frequencies. The experimental dispersion of dielectric constant data with dilute zein solutions in the frequency range 25000 to 30,000,000 ∼ is accounted for quantitatively by theoretical equations if the molecules are treated as ellipsoids of revolution. The values 38000 for the molecular weight and 1/7 for the ratio of minor to major axis of the zein molecule are obtained directly from these data. It has been possible to analyse the dispersion of dielectric constant curve for zein in solution by considering the molecule to have the form of an ellipsoid of revolution to give relaxation times characteristic of rotation about its different axes. There is no dielectric constant evidence of a temperature dissociation of zein molecules in solution between 0 and 50°. AUTHORS.

2202. Dielectric Constant of Ammonium Sulphate near the Transition Point. R. Guillien. *Comptes Rendus*, 208. *pp.* 980–981, *March* 27, 1939.—As temperature is decreased the dielectric constant of $(NH_4)_2SO_4$ passes through a sharp maximum at the transition point, λ, − 53·4°. The dielectric absorption, which is almost zero above λ becomes a maximum at this temperature, and then slowly decreases. There is also a maximum value of the specific heat at − 53·4°. A. J. M.

2203. Free Charges, Polarisation and Polarisation Charges, especially on Insulators Moving in Magnetic Fields. S. J. Barnett. *Am. Phys. Teacher*, 7. *pp.* 28–35, *Feb.*, 1939.—A brief systematic treatment is given of the subject of the polarisation of insulators in an ordinary electric field. The treatment is then applied to cases in which polarisation is produced in insulators and free charges in conductors by their motion in a magnetic field. After dealing with various modifications of the parallel plate condenser, consideration is given to the case of a hollow insulating cylinder with thin conducting coats rotating in a uniform magnetic field with induction parallel to its axis. The free charge which occurs instead of a polarisation charge when the insulating cylinder is replaced by a conducting one is also determined. R. W. P.

See also Abstracts 1940, 2168 and

1000B. Absorption and Reflection Measurements in the 1 cm. Wave Region. W. Kebbel.

1035B. Measurement of Small Capacitance. V. Fritsch.

ELECTROCHEMISTRY.

***2204. Saturated Standard Cells with Small Temperature Coefficients. Part III. W. C. Vosburgh and H. C. Parks.** *Am. Chem. Soc., J.* 61. *pp.* 652–654, *March*, 1939.—An investigation has been made of the composition limits for cadmium-bismuth amalgams within which the cadmium activity is independent of the composition between 10 and 40°. [For Part II see Abstract 3718 (1937).] AUTHORS.

2205. Verification of Faraday's Laws Relating to the Positive Pole in Spark Electrolysis. P. de Beco. *Comptes Rendus*, 208. *pp.* 797–798, *March* 13, 1939.—Faraday's laws relating to the negative pole are well known [see Abstract 3325 (1936)]. Experimental work is described in connection with acidity and neutral solutions at the positive pole with both O_2 and H_2 atmospheres. The technique is detailed. Two classes of salts are found: (1) sulphates, nitrates, phosphates, chlorides, etc., giving an acidity verifying Faraday's law. (2) Acetates, iodides, etc., giving a negative acidity to the positive pole. Faraday's law is thus experimentally confirmed for a range of salts. E. H. W. B.

2206. Electrostatic Influence of Substituents on Dissociation Constants of Organic Acids. Part III. F. H. Westheimer and M. W. Shookhoff. *Am. Chem. Soc., J.* 61. *pp.* 555–560, *March,* 1939.—The new mathematical formulation, by Kirkwood and Westheimer [see Abstract 4217 (1938)], of the electrostatic effect of a substituent, has been shown to account satisfactorily for the ratio of the ionisation constant of a dibasic acid, for the ratio of the ionisation constant of a dipole substituted acid to that of the unsubstituted acid, for the ratio of the ionisation constant of an amino acid with that of a salt of its ester. The theory also accounts for the effect of alkyl groups and, at least in the few cases which can now be examined, for the effect of solvent, upon the ionisation constant ratio. AUTHORS.

2207. Polarographic Study of Unalterable Polished Electrodes. Analogy between Structures of a Beilby Surface and of Liquid Mercury. F. J. Taboury. *Comptes Rendus,* 208. *pp.* 887–889, *March* 20, 1939.—The polarograms obtained with a cell in which the kathode consisted of a Pt wire embedded in glass and cut off flush with the surface and polished [see Abstract 2788 (1937)], and the anode of a sheet of Pt are characteristic of the electrolyte and very similar to those obtained with the dropping Hg electrode. Similar results were obtained when the polished Pt electrode was anode. The results support the view that the structure of a polished metal surface resembles that of a liquid [see Abstract 3526 (1933)]. C. A. S.

2208. Normal Electrode Potential of Cæsium. H. E. Bent, G. S. Forbes and A. F. Forziati. *Am. Chem. Soc., J.* 61. *pp.* 709–715, *March,* 1939.—The cells Cs/CsI in (CH$_3$)$_2$NH/Cs amalgam and Cs amalgam /CsOH aq/HgO,Hg were studied at various temperatures using special apparatus and methods required by the high reactivity of Cs. Cells of the former type were stable within a few mV for two weeks or more. Those of the second type, using a flowing amalgam, were subject to a gradual increase in concentration of CsOH which was determined analytically over each electrode. Given the activity coefficient of CsOH at each concentration at each temperature, the proper correction at each electrode and at each time was calculated. The e.m.f. thus corrected was reproduced, on the average, within 1mV upon returning to any given temperature. From the corrected data, E^0, the normal electrode potential of solid Cs at 0, 5, 10, 15, 20 and 25° was obtained. That of liquid Cs is found at 30° only. In addition, the activity of Cs in 0·2827 atom per cent Cs amalgam at each temperature, also enthalpy changes and free energy changes for each of three reactions are evaluated. Among the data given, those of most interest are perhaps E^0 for Cs at 0 and 25°, 2·952 V and 2·923 V, respectively, very close to the corresponding value for Rb, but still 34 mV below that for Li. AUTHORS.

2209. Reproducibility of Silver-Silver Halide Electrodes. J. K. Taylor and E. R. Smith. *Bureau of Standards, J. of Research,* 22. *pp.* 307–314, *March,* 1939.—Tests of the reproducibility in potential of the electrolytic, thermal-electrolytic, and thermal types of Ag-AgCl, Ag-AgBr, and Ag-AgI electrodes, in both acid and neutral solutions, are reported. All of these silver-silver halide electrodes show an ageing effect, such that freshly prepared electrodes behave as kathodes towards electrodes previously aged in the solution. They are not affected in potential by exposure to light, but the presence of O$_2$ disturbs the potentials of the Ag-AgCl and Ag-AgBr electrodes in acid solutions, and of the Ag-AgI electrodes in both acid and neutral solutions. Except in the case of the Ag-AgI electrodes, of which the thermal-electrolytic type seems more reliable than the electrolytic or the thermal type, the equilibrium potential is independent of the type, within about 0·02 mV. AUTHORS.

2210. Effect of Solubility of Glass on Behaviour of Glass Electrode. D. Hubbard, E. H. Hamilton and A. N. Finn. *Bureau of Standards, J. of Research*, 22. *pp.* 339–349, *March*, 1939.—Application of an interferometer method previously used for determining the relative solubility of optical glasses, to a glass which is commonly used for making glass electrodes, gave results leading to the following conclusions. The solubility increases rapidly as the pH of most solutions increases above 8·5 or 9. At all values below pH 7 for the solutions investigated (except 10 *N* H_2SO_4) this glass exhibits a slight swelling. The rate of swelling is repressed in the acid region beyond pH 2. At intermediate pH values 3·1 to 4·0 the rate of swelling is repressed by high concentrations of $MgSO_4$. Considering these conclusions in connection with the performance of glass electrodes, these regions of marked solubility change correspond to the regions of pronounced voltage departures exhibited by electrodes made from this glass. That the anomalies of the glass electrode are definitely associated with the solubility of the glass has been further demonstrated both by the use of glasses which do not exhibit swelling in the acid range (and hence no detectable change of swelling in the "super-acid" region), and by measurements made in alkaline solutions, such as aqueous ammonia, in which soluble silicates are not formed. Under these circumstances the voltage departures are greatly decreased or completely eliminated. For every case investigated, voltage departures of the glass electrode have been found to be accompanied by changes in the solubility of the glass. AUTHORS.

2211. Chromate-Chromic Electrode Potential. S. A. Durban and D. J. Brown. *J. Phys. Chem.* 43. *pp.* 491–493, *April*, 1939.—This study of the chromic–chromate–perchloric acid half-cell indicates a reversible oxidation potential of 1·195 ± 0·010 V.

2212. New Method of Studying Polarisation of Voltaic Cells. E. Toporescu. *Comptes Rendus*, 208. *pp.* 1004–1005, *March* 27, 1939.—A cell made up of Zn and Hg electrodes in a concentrated solution of $ZnSO_4$ gave a current of 20 mA decreasing to 2·2 mA on short circuit after 72 hr. The pH of HCl placed in contact with the Hg which had been in the cell increased, but remained constant when the HCl was placed in contact with pure Hg. It is concluded that the Hg from the cell must have contained a little Zn, which had been deposited on the electrode by electrolysis due to the p.d. between Hg and Zn. A. J. M.

2213. Polarisation on Ni-Fe-Co-Alloy Electrodes during Oxygen Evolution in Alkaline Solutions. G. Grube and W. Gaupp. *Zeits. f. Elektrochem.* 45. *pp.* 290–296, *April*, 1939.—Measurements of the current density-potential curves during the evolution of O_2 formed by electrolysis of alkaline solutions with electrodes of Ni-Co-Fe alloys, together with the curves showing the change of potential with time, at constant current density in solutions of 7 *N* KOH at 60° C. led to certain conclusions. As in the case of Ni, the alloys showed a change in anode potential over a period of time. Alloys containing 80% Fe showed this anode potential change with time in a much greater degree than pure Ni. In alloys containing 90–95% Fe, the potential fell with time, but the metal was not completely passive. Ni-Co alloys showed a less rapid rise of anode potential than pure Ni. F. J. B.

2214. Local Elements on Metal Electrodes. V. Čupr. *Zeits. f. Elektrochem.* 45. *pp.* 297–303, *April,* 1939.—As an investigation into passivity and corrosion phenomena, the author considers the local potentials and local currents arising from local varations in the surface of a metal. He is mathematically concerned with a number of local elements with the same or different e.m.f.s, and shows how measurements can be made to determine the resistance of the surface layer. L. E. C. H.

2215. Surface Chemistry of Pt Electrode. B. Ershler and A. Frumkin. *Faraday Soc., Trans.* 35. *pp.* 464–467, *April,* 1939.—Various methods of investigating the surface of platinised and bright Pt electrodes are described and the more important results obtained briefly summarised. [See also Abstract 3113 (1938).] AUTHORS.

2216. Corrosion of 18-8 Stainless Steel. R. H. Brown and R. B. Mears. *Faraday Soc., Trans.* 35. *pp.* 467–474, *April,* 1939.—It is demonstrated that the principal effect of ferric chloride in stimulating the corrosion of 18-8 stainless steel is to reduce kathodic polarisation. Ferric chloride has relatively little effect on anodic polarisation. As a result of this action, in solutions containing substantial amounts of ferric chloride, the occurrence of initial corrosion breakdowns on stainless steel cannot be detected by single potential measurements. This finding emphasises the undesirability of using single potential measurements to detect the occurrence of initial corrosion breakdowns in cases where the polarisation characteristics of the metal and solution are not understood. AUTHORS.

2217. Potential of Alloy Steels as a Measure of Corrosion Resistance. F. Arbitrio. *Chim. e l'Industria,* 20. *pp.* 791–793, *Dec.,* 1938.—The author reviews the chief methods of assessing corrosion resistance by measuring the potential assumed by the alloy in contact with the corroding agent. Disadvantages of the method of measuring the current in the cell alloy|solution|Pt are that polarisation occurs, and that the electrochemical equivalent of the alloying elements is not the same as that of Fe, the potential of the alloys in 10% HCl, H_2SO_4, and HNO_3 is therefore measured by potentiometer. Results are reported for six "stainless" steels as 70 × 40 × 5 mm. plates with sandpapered surfaces the time taken to reach a stationary value being also quoted. The potential diminishes with diminishing content of alloying elements. In HNO_3 all the alloys examined became completely passive. When loss in weight per cm². in 48 hr. in 10% HCl is plotted against equilibrium potential the curve is parabolic about the ordinate $E = -0{\cdot}3$ V as axis. The depassifying effect of the Cl' and SO_4' ions is discussed. D. R. H.

2218. Behaviour of Mercury Amalgams in Solutions Containing Mercury and other Ions. T. Erdey-Grúz and L. Erdey. *Zeits. f. phys. Chem.* 183. *Abt. A.* 6. *pp.* 401–422, 1939.—The potential which different amalgam electrodes assumed in solutions containing Hg, or free from Hg-ions was investigated. Indefinite results were obtained when the ionic solutions were diluted with pure water. When the dilution was carried out with solutions containing another ion than Hg in addition to the Hg-ions, the Nernst law was obeyed up to dilutions of 10^{-5} *N*. Different amalgams, containing Zn, Cd, Pb, Sn, Tl, Bi and Cu were investigated in solutions free from the ions of the particular metal and free from O_2. The potential assumed by the amalgam was found to be independent of the concentration of the dilute amalgams to a concentration of 10 gm.atoms/l. F. J. B.

See also Abstracts 1955, 2160, 2163.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2219. Capture of Mesotrons by Atomic Nucleus. S. Sakata and Y. Tanikawa. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 58–65, *Feb.*, 1939. *In English.*—In the first part of this paper, the non-relativistic theory of the interaction of mesotrons with heavy particles is developed. This theory is then applied to the absorption of a positive (negative) mesotron by an atomic nucleus with subsequent emission of a proton (neutron), and it is found that the cross-section per neutron (proton) in the nucleus is given by $\phi = 4\cdot 5 \times 10^{-28}\, c/v$ cm^2., where $v \ll c$. AUTHORS.

2220. Scattering of Fast Neutrons by Atoms. S. Kikuchi and H. Aoki. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 75–89, *Feb.*, 1939. *In English.*—The scattering cross-section of 38 elements for D + D- and for Li + D-neutrons is investigated by absorption experiments in which a cylindrical sample of the scattering substance is interposed in the neutron beam whose intensity is measured in a methane filled ionisation chamber. The D + D-neutrons used were fairly monochromatic, their energy varying between 2·38 and 2·50 eMV, while the spectrum of the Li + D-neutrons was more extended, the average energy being higher. An estimate of the order of magnitude of true absorption- and inelastic scattering effects shows that about 95% of the observed cross-sections must be due to elastic scattering. The cross-section seems to be a continuous function of the atomic number. This function, however, does not increase monotonically with the atomic number, as was suggested by Dunning and co-workers [see Abstract 3719 (1935)], but passes through a number of distinct maxima and minima recalling some of the regularities of the periodic table. The curves are similar but not identical for the D + D- and Li + D-neutrons, while Leipunsky and co-workers, investigating the light elements with photoneutrons from Be, obtained completely different results [see Abstract 1412 (1937)]. The variation of the scattering cross-section with neutron energy, indicated by those differences, is again not monotonic. These circumstances, it is suggested, point to the occurrence of resonance phenomena in the elastic scattering of neutrons. L. E. F.

2221. Absorption of Neutrons of Medium Energy. J. H. E. Griffiths. *Roy. Soc., Proc.* 170*A*. *pp.* 513–519, *April* 21, 1939.—The absorption of neutrons produced by the γ-rays of Ra on Be in 18 elements has been investigated by comparing the activities of the artificially radioactive isotopes produced. The absorption coefficient of the β-rays has also been found which enables the relative values of the neutron absorption cross-section to be calculated. The results are compared with the theoretical prediction of a smooth increase of cross-section with atomic weight and some reasons for the large differences obtained are discussed. The absolute value of the cross-section is estimated as 1×10^{-25} cm^2. for Ag compared with the theoretical value of 2×10^{-25} cm^2. AUTHOR.

2222. Influence of Absorption on Diffraction of Electrons. Parts I and II. P. A. Thiessen and K. Molière. *Ann. d. Physik*, 34. 5. *pp.* 449–472, *March*, 1939.—In Part I electron-diffraction measurements are made of the inner potential of zinc-blende. Values differing from each other by more than the experimental error are obtained from the lower order reflections. Possible reasons are suggested and in Part II Bethe's theory is used to calculate the effect of absorption of the electrons. The results do not account for the discrepancy and other factors such as variations in the lattice constant and irregularity of the crystal surface are probably involved. F. C. C.

2223. Theory of Width of Rings Formed by Electron-Diffraction. G. P. Thomson and M. Blackman. *Phys. Soc., Proc.* 51. *pp.* 425–431, *May*, 1939.—The widths of the diffraction rings formed by transmitted electrons are examined from the point of view of Bethe's theory. It is shown that these angular widths are much less than the range of angle of incidence giving strong reflection, an exception occurring in the Bragg case, where the beam enters and leaves by the same crystal face. This explains most of the discrepancy found by Trillat and Hautot between the theoretical and observed widths of diffraction rings [see Abstract 2685 (1938)]. AUTHORS.

2224. Diffraction of Electrons by Anthracene. A. Charlesby, G. I. Finch and H. Wilman. *Phys. Soc., Proc.* 51. *pp.* 479–526; *Disc.*, 527–528, *May*, 1939.—The diffraction of electrons by anthracene crystals gives results which are in agreement with the structure as previously determined with X-rays. In addition to the normal type of multispot pattern characteristic of electron diffraction by thin single crystals, however, there appears superimposed another pattern consisting of areas or islands of diffuse scattering. It is shown that this diffuse-area pattern is due to molecules which, though oriented with respect to the beam in accordance with the crystal-orientation, have nevertheless no definite phase relationship with each other. The diffuse-area pattern is thus virtually equivalent to that which would be given by a gaseous stream of oriented molecules flowing past the electron beam. Since the crystal setting cannot as a rule be directly observed as it can in X-ray analysis, it has been necessary to develop methods for determining the crystal orientation from a consideration of the normal electron-diffraction pattern features. In this way it was established that the diffuse-area pattern was furnished by molecules which, though in, or very near, their normal positions and orientations within the lattice, were acting as independent scattering groups. It is shown, by an extension of the Debye theory to molecular lattices, that the occurrence of the diffuse-area pattern in electron-scattering by molecular crystals can be satisfactorily accounted for on the supposition that the molecules vibrate thermally as practically rigid units about their mean positions within the lattice. It is pointed out that the diffuse-area pattern can be regarded as an important adjunct to the X-ray Fourier synthesis method of determining molecular and crystal structure, in cases where the atomic arrangement within the molecule exhibits a sufficient degree of symmetry. Furthermore, it offers an approach to the study of molecular structure in cases in which the method of electron diffraction by gases fails owing to the complex nature of the pattern resulting from the lack of orientation of the molecules in the gaseous stream. AUTHORS.

2225. Integration of the Equations of Motion of a Charged Particle of Variable Mass under the Influence of Arbitrary Electric and Magnetic Fields. I. Opatowksi. *Comptes Rendus*, 208. *pp.* 638–640, *Feb.* 27, 1939.—The problem can be reduced to that of finding two families of surfaces which are orthogonal to each other and to the equipotentials of the magnetic field. R. P.

2226. Total Secondary Electron Emission from W and Th-Coated W. E. A. Coomes. *Phys. Rev.* 55. *pp.* 519–525, *March* 15, 1939.—The secondary electron emission from polycrystalline W covered with monomolecular films of Th evaporated on to it from a thoriated W filament, has been investigated over an energy range for primary electrons of 100 to 1000 V. The state of the target surface was ascertained from thermionic emission measurements. For clean Th on clean W apparently the secondary emission coefficient did not change with thoriation for primary energies below 200 V, but decreased at higher voltages with increasing amounts of Th on the target. No observed increase in secondary emission takes place with a reduction in the work function of W by a monomolecular layer of pure Th; apparently there is a decrease in secondary emission in this case. When the Th-coated W was treated with O_2 released from the thoriated W filament the work function increased, but there obtained also an increase in the secondary emission coefficient; further change in work function by evaporation of Th caused a variation of the secondary emission coefficient that other experimenters also have observed. AUTHOR.

***2227. Demonstration of Ramsauer Effect with an Oscillograph. R. Kollath and E. Steudel.** *Zeits. f. techn. Physik*, 20. 2. *pp.* 36–38, 1939.—An apparatus is described for measuring the absorption of l.v. electrons by A at low pressure. The same apparatus, in conjunction with an oscillograph, may be used to demonstrate the variation of electron absorption as the gas pressure is altered. A number of oscillograms are given in illustration. H. J. H. S.

***2228. Experimental Proof of Phase Focusing. L. Mayer.** *Zeits. f. techn. Physik*, 20. 2. *pp.* 38–42, 1939.—An apparatus is described for demonstrating the existence of phase focusing. It consists of a small ultra h.f. accelerating field (phase lens) through which passes a beam of electrons modulated sinusoidally at ultra h.f. The beam then passes through crossed electric and magnetic field and a space-time alteration in intensity is observed which is due to phase focusing. H. J. H. S.

2229. Simplified Derivation of General Properties of an Electron-Optical Image. E. G. Ramberg. *J.O.S.A.* 29. *pp.* 79–83, *Feb.*, 1939.—It is possible, by elementary concepts only, to deduce the imaging properties including the complete form of the aberrations of the third order of an electron-optical system. In the case of an axially symmetrical electric field, this is possible by symmetry considerations alone (except for the coma angle) whilst for an axially symmetrical electric and magnetic field it is possible (except for the coma angle and the eccentricity of the ellipse of magnetic astigmatism) by symmetry considerations in conjunction with an extension of Larmor's theorem. The introduction of the wave surface is necessary in order to determine the coma angle and the eccentricity of the ellipse of magnetic astigmatism. H. J. H. S.

2230. Aberrations of Orthogonal Electron-Optical Systems. M. Cotte. *Ann. de Physique*, 11. *pp.* 351–352, *March*, 1939.—A relativity correction is applied to expressions derived in a previous paper [see Abstracts 1315 (1938) and 437 (1939)]. H. J. H. S.

***2231. Search-Coil Oscillator for Measuring Fields of Magnetic Electron Lenses. O. Klemperer and H. Miller.** *Journ. Sci. Instruments*, 16. *pp.* 121–123, *April*, 1939.—A gear is described which is suitable for the investigation of magnetic fields with rotational symmetry and for measuring small inhomogeneities in these. The gear contains an extremely small coil performing a reciprocating rotational motion. The terminals of the coil are, without using slip rings, directly connected to a resonance amplifier, tuned to the frequency of the coil oscillations. The procedure of field measurement is illustrated for the case of an iron-clad magnetic electron lens. [See Abstract 3406 (1938).] AUTHORS.

See also Abstract 1927, and

1042B. Over-Control Spectrum of a Kathode-Ray Tube. H. E. Hollmann.
1045B. Electrostatic Electron Optics. F. Gray.

ELECTROSTATICS.

2232. Interchange of Electricity between Solids, Liquids, and Gases through Mechanical Action. S. K. Banerji. *Indian Journ. Phys.* 12. *pp.* 409–436, *Dec.*, 1938.—The separation of electrical charges in mechanical interactions such as occur for example when gas leaves a jet and impinges on a plate is considered. The total charge of the different media involved is unaffected but the distribution can show a wide range of variation depending on the substances and processes involved. The charge developed on a medium depends on the violence of the mechanical action. Only a part of the mechanical work is converted into electricity. The exchange of electricity occurring in such processes can be explained in terms of an electrical double layer. Several examples of such interchanges are examined. R. D.

***2233. Apparatus for Charging Electrometers. H. Walch.** *Zeits. f. techn. Physik*, 20. 3. *pp.* 82–83, 1939.—An arrangement is described for charging an electrometer to several hundred volts from a l.v. source such as a primary cell. It consists of a parallel plate condenser, the capacity of which can be varied over a wide range. R. D.

See also Abstracts 1959, 2203.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2234. Longitudinal Magneto-Resistance Effect in Fe-Si Alloys. Y. Shirakawa. *Tohoku Univ., Sci. Reports*, 27. *pp.* 255–277, *Jan.*, 1939. *Report No.* 449 *of the Research Inst. for Iron, Steel and other Metals. In English.*—The change in electric resistance ($\Delta R/R$) of alloys of the Fe-Si system at various temperatures ranging from − 195° to 850° was measured up to 1600 oersteds in longitudinal magnetic fields. The specimen used was a fine wire, $0\cdot33 \sim 0\cdot77$ mm. in dia. and $1\cdot52 \sim 6\cdot40$ cm. in length. It is shown that the maximum value of the $\Delta R/R$ in Fe at about + 100° (field intensity of 1500 oersteds) displaces towards higher temperatures with increasing addition of Si and then its magnitude gradually decreases in respect to Si content. The $\Delta R/R$ of the alloys containing more than 9·43% Si at all temperatures and under any magnetic field is negative, its magnitude being especially large in alloys containing 14·60% and 16·03% Si. AUTHOR.

See also Abstracts 2129, 2144.

MAGNETISM AND ELECTROMAGNETISM.

2235. Magnetic Force Due to a Conical Body. H. Higasinaka. *J. Shanghai Sci. Inst.* 1. *pp.* 199–204, *Feb.*, 1939.—A mathematical study in which a formula is obtained for the gravitational potential at any point of a conical mass. S. A. S.

2236. Shape of the Domains in Ferromagnetics. E. H. Kennard. *Phys. Rev.* 55. *pp.* 312–314, *Feb.* 1, 1939.—It is generally agreed that, in a demagnetised ferromagnetic crystal, the domains contain 10^{12} to 10^{15}

atoms but there is no agreement about the shape of the domains. It is often assumed that these are approximately cubical but objections are raised to this assumption and it is argued that the domains in Fe and presumably in all ferromagnetic crystals must have the form either of slender filaments or of thin plates magnetised longitudinally. The problem of the stability of the domains is examined. H. J. H. S.

2237. Ferromagnetic Transformations. W. Gerlach. *Zeits. f. Elektrochem.* 45. *pp.* 151–166; *Disc.*, 166–170, *Feb.*, 1939.—A comprehensive review is given of the physical, chemical and mechanical properties of ferromagnetics in the region of the Curie point and the problems which arise are briefly discussed. H. J. H. S.

2238. Theory of Reversible Magnetisation in Ferromagnetics. W. F. Brown, Jr. *Phys. Rev.* 55. *pp.* 568–578, *March* 15, 1939.—In the statistical domain theory of Heisenberg and others it is assumed that the domains have constant volumes, but that their magnetic moments change from one direction to another as the field or stress is changed. This model is highly artificial, for the actual process is believed to be a growth of some domains at the expense of others by displacement of the boundary between them. In this article the equations of the statistical theory are derived without use of the simplified model, by an adaptation of Kondorsky's analysis of the boundary displacement process. The assumptions necessary for this derivation are discussed critically, and the effect of modifying them is investigated in several special cases. AUTHOR.

2239. Magnetic Properties of Fe-Ni-Al Alloys. J. L. Snoek. *Physica*, 6. *pp.* 321–331, *April*, 1939. *In English.*—The author studies the alloys in terms of the "inner-demagnetising factor" N_i, defined as $(N_{measured} - N_{calculated})$. For quenched specimens this is zero, but on subsequent heat-treatment N_i always lags behind H_c. It appears that alloys of composition $(Fe_2)_x(NiAl)_{1-x}$ after slow cooling are heterogeneous almost up to NiAl. After quenching from 1200° C. and tempering at 500° C., magnetic saturation values are found to be almost exactly proportional to Fe content; probably therefore the line joining Fe and NiAl is a co-node in the ternary system. If, however, the alloys are slowly cooled from 1200° to 500° C. before tempering, the plot between 10 and 60% Fe is displaced parallel to the original plot for the quenched specimens. This is attributed to formation of a face-centred phase. Attention is drawn to the possibility of vitiation of X-ray results by loss of Al from the surface of powdered alloys on heat-treatment and by transformation of some of the solid solution into the face centred phase on cooling [see Abstract 2671 (1938)]. To avoid errors, saturation values were determined with a magnetic balance. D. R. H.

***2240. Magnetic Saturation Intensities at Different Temperatures. W. Sucksmith.** *Roy. Soc., Proc.* 170*A*. *pp.* 551–560, *April* 21, 1939.—A paper describing a new method of measurement by which a high degree of accuracy can be obtained at any temperature when only a few cubic mm. of substance is used. A ferromagnetic specimen is placed in a non-uniform magnetic field between the poles of an electromagnet having specially shaped conical faces consisting of three different inclined planes. The field gradient dH/dx is a maximum at approximately the centre of the pole gap and this is the position occupied by the specimen which experiences a tractive force into the stronger field of magnitude MdH/dx, where M is the magnetic moment of the specimen. If the specimen moves only over a distance where the field gradient remains constant, the forces exerted on different specimens are directly proportional to their moments, thus enabling intensities of magnetisation to be compared. The apparatus used is described in detail and test results are recorded. S. A. S.

2241. Constant Paramagnetism of Tetravalent Cerium and Other Ions Having the Same Number of Electrons as the Inert Gases. G. Foëx. *Comptes Rendus*, 208. *pp.* 738–740, *March* 6, 1939.—The first seven members of the Fe elements can form compounds in which the valency is equal to the total number of their 3*d* and 4*s* electrons. These ions have the same configurations as A. The first three of these, K^+, Ca^{++}, and Sc^{+++}, are diamagnetic, but the remainder are feebly paramagnetic. The paramagnetism is independent of temperature, and increases with the charge on the ion. The atomic susceptibilities of the elements in this series, and of the similar series higher in the periodic table are collected. A new determination of the molecular susceptibility of $Ce(SO_4)_2, 4H_2O$ is reported the value obtained being -97×10^{-6}, from which the value for Ce^{++++} is deduced to be $+22 \times 10^{-6}$. A. J. M.

2242. Magnetic Susceptibility of Oxyhaemoglobin. P. Berthier. *Comptes Rendus*, 208. *pp.* 943–945, *March* 20, 1939.—The material in the form of crystals was dissolved at a low temperature in a KCl solution of known strength. The magnetic measurements were made with a Curie-Cheneveau balance, and the mean susceptibility of four specimens was $k = +0{\cdot}34 \times 10^{-6}$. On bubbling CO_2 and H_2S through the solution, increases of susceptibility took place, the new values being respectively $+0{\cdot}58 \times 10^{-6}$ and $+1{\cdot}04 \times 10^{-6}$. G. E. A.

2243. Vector Potential of Field of a Torus Carrying a Current. G. Schenkel. *Ann. d. Physik*, 34. 6. *pp.* 541–560, *March*, 1939.—It is required to find the electric field produced by the rotation of a torus, in which a current flows, about an axis lying in the plane of the torus. If the torus is of circular cross-section, rapidly converging series for the vector-potential can be found. For a torus of square section, or for one of infinitely thin section, the corresponding infinite series can be represented in terms of elliptic integrals. G. C. McV.

2244. Spontaneous Energy and Gravitational Field of an Electrical Point Charge. H. Hönl and A. Papapetrou. *Zeits. f. Physik*, 112. 1–2. *pp.* 65–85, 1939.—The most general spatial spherically-symmetrical statical solution of the field equations of the gravitational and electromagnetic field are given for an electrical point charge, in which an integration constant occurs which may be regarded as the radius of the point charge (electron radius). The spontaneous energy of the point charge, when its mass is assumed to be of purely electromagnetic origin, is finite in every case, and possesses an upper limit which corresponds for the charge $e = 4{\cdot}77 \times 10^{-10}$ e.s.u. to a mass of $1{\cdot}85 \times 10^{-6}$ gm. This result conforms in all essential features with the theory of Born and Infeld, without it being necessary, however, to amend the Maxwell equations. H. H. Ho.

***2245. Mutual and Self Inductors Compensated for Change of Frequency. A. Campbell.** *Phys. Soc., Proc.* 51. *pp.* 539–544; *Disc.*, 544, *May*, 1939.—The effects of self and mutual capacitance on the electrical constants of mutual and self inductors can be compensated by various devices. For mutual inductors the usual system is a closed tertiary circuit coupled to both primary and secondary coils; the complete case of this is discussed mathematically and it is also shown that a similar arrangement (of closed secondary circuit) is effective for self inductors. A simpler system for these consists of a non-inductive shunt across the terminals, but the closed secondary is usually preferable. Several experimental examples are given. AUTHOR.

See also Abstracts 1938, 1961, 2142, 2143, 2144, 2176.
1072B. Magnetic Screening. F. Moeller.
1073B. Measurement of Coercive Force. H. Neumann.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***2246. Einthoven String Galvanometer Used with a Valve Microvoltmeter. W. R. Miles.** *Rev. Sci. Instruments*, 10. *pp.* 134–136, *April*, 1939.—The Einthoven galvanometer may be successfully combined with a valve microvoltmeter used as input. The resulting d.c. instrument is especially useful when bioelectrical or other steady or transitory small potentials are to be measured. The advantages of the combined instrument include the following: (1) The influence of tissue and electrode resistance is reduced to a minimum. (2) Current drainage from the measured specimen is reduced to a minimum. (3) The index of the measured potential is or may be slightly amplified. (4) The deflection speed of the string galvanometer is slightly improved. The combination instrument when equipped with good batteries is stable, its upkeep is not troublesome, and it has practical use in a wide range of problems. The chief disadvantage is sensitiveness to pick-up disturbance which is common to an apparatus employing thermionic valves. With careful shielding and scrupulous avoidance of miscellaneous a.c. equipment active about the laboratory this difficulty can, as a rule, be successfully controlled. AUTHOR.

***2247. Clinical Dosage Meters Using a Thimble Ionisation Chamber. M. C. Reinhard.** *Radiology*, 32. *pp.* 282–283, *March*, 1939.—An analysis of the errors that may be introduced in the measurement of the amount of X-radiation delivered to a patient when using thimble ionisation chambers. In the case of ionisation chambers which measure the radiation transmitted through the filter, thus acting as a check upon the filter as well as upon the output of the generator, it was found that even for X-rays generated at 400 kV the chamber tube casts an appreciable shadow detectable even at depths of 50 cm. In the case of ionisation chambers, calibrated to read directly in röntgens, which are placed on the skin of the patient and measure both the incident and scattered radiation, it is shown by means of radiographs, taken by films inserted in a wooden phantom, that appreciable shadows are evident. Attention is also drawn to the fact that the variation in intensity may be 12% with the degree of submergence of the chamber on the skin surface and if the chamber is located at the periphery of the treatment area the centre may actually receive 20% more radiation than that indicated by the dosage meter.

T. A. C.

2248. Influence of Low Temperature on Recovery from X-Rays. E. V. Cook. *Radiology*, 32. *pp.* 289–293, *March*, 1939.—One-cell *Ascaris* eggs, when allowed to develop at 25° C. immediately after exposure to a dose of 5,000 röntgens of X-rays generated at 130 kVp delivered at a rate of 200r/min., showed only 1–2% normal embryos, whereas eggs receiving the same dose and placed at 5° C. for 8 weeks, developed approximately 45% normal embryos when returned to 25° C. This would indicate a significant influence of low temperature upon recovery from irradiation effects. Obviously the embryos, both normal and abnormal, are a measure of the irradiation effects upon cell division as well as upon cell differentiation. In this paper, however, no attempt was made to separate the two effects [see Abstract 857 (1939)]. Although it is quite evident from the results of these experiments that recovery did occur, the delay in cleavage caused by a dose of 5,000r was the same throughout the experiment and showed no evidence of being influenced by low temperature. T. A. C.

2249. Experimental Study of Diffused X-Rays and Their Radiotherapeutic Application. J. Ducuing, L. Bugnard, P. Marquès and G. Cabazat. *J. de Radiologie and d'Électrologie*, 23. *pp.* 105–117, *March*, 1939.—The transmission and therefore absorption of X-rays depends upon various external factors such as tube voltage, intensity, distance of the tube and the volume of tissue radiation. The latter plays an important part in view of secondary or diffused radiation due to fluorescence effects and the Compton effect. The greater the volume irradiated the greater are the latter effects. Measurement of this diffused radiation is influenced by the characteristics of the ionisation chamber used, in respect to its size, nature of its walls, etc. The present paper deals with practical measurements of this secondary diffused radiation, much data being given in the form of curves and tabular data. These results are applied to practical therapeutic purposes with the object of increasing the secondary radiation component, so diminishing the time of application for a given dose, in the patient's favour, with more generalised intensity and dosage and the possible application of heavier dosages, particularly since the secondary radiation component is more absorbed than the primary incident radiation. B. J. L.

***2250. Progress in Construction of H.V. X-Ray Tubes at the California Institute of Technology. C. C. Lauritsen.** *J. de Radiologie et d'Électrologie*, 23. *pp.* 97–104, *March*, 1939.—Constructional details are given of X-ray tubes constructed for operation at 1200 kV and applied for actual purposes of X-ray treatment at 900 kV and 3 mA tube current, via filters of 6 mm. of steel and 1 mm. of lead. The first tube built in 1928 was for operation at 300 kV but intermittent operation at 750 kV was obtained with a cold, *i.e.*, non-filament, kathode. This tube was improved for regular operation at 600 kV and then, by utilisation of two such tube elements in opposition with earthed mid-point, a voltage of operation of 1000 kV was obtained, in spite of difficulties in transformer design. Since Oct., 1933, regular therapeutic treatments have been given. The tube is in constant connection with the vacuum pump and the present tube is very simple in general design. Depth dosage in respect to such high voltage X-rays is discussed and the relative importance of small and large areas of irradiation and the focus-skin distance. In respect to the latter, with such h.v. radiation, increase of the focus-skin distance has relatively little effect. The possibility of selective action of particular wave-lengths is discussed but up to the moment this possibility has not been definitely proved. B. J. L.

***2251. H.V. Demountable X-Ray Tube. W. H. Kliever.** *Rev. Sci. Instruments*, 10. *pp.* 126–128, *April*, 1939.—This tube consists of a minimum number of simple parts easily made in a university workshop. It is designed for steady operation up to at least 110 kV, and permits convenient interchange of targets, replacement of filaments, etc. AUTHOR.

2252. Action of Radioactive Radiations on Microbes. S. Metalnikov, A. Yakimach and O. Yadoff. *Comptes Rendus*, 208. *pp.* 605–608, *Feb.* 20, 1939.—Radioactive sources in the form of Rn contained in glass

capillaries have been inserted in nutrient media inoculated with *sarcina* and placed in an incubator at 35° C.–37° C. After intervals of 2, 4 and 10 days the cultures were stained by fuchsine and examined microscopically. In the case of the Rn capillaries containing 3, 5 and 20 mC. the culture was more dense than in the control experiment, but surrounding the capillary containing 60 mC. of Rn the multiplication of the microbes was insignificant. The feeble dose stimulates the multiplication of the microbes while the strong dose weakens and kills the culture. In addition to this effect on the rate of growth, there is a change in structure, which is illustrated by photographs, also four new mutations are shown to be induced by the strong dose.
T. A. C.

2253. **Estimation of " Quality " of Depth Radiations in γ-Ray Therapy. C. W. Wilson.** *Brit. J. of Radiology*, 12. *pp.* 231–238, *April*, 1939.—A method is described whereby the quality of " tissue " radiations in radium therapy may be estimated from the ratio of the ionisations produced in ionisation chambers, of materials having different atomic numbers. Using the method, a study has been made of the quality of the tissue radiations for various conditions approximating to those used in therapy. The results and their implications are discussed. The results show that elektron-metal ionisation chambers should be quite satisfactory for the measurement of depth radiations in radium teletherapy. AUTHOR.

2254. **Protective Materials in the Use of Radium Surface Applicators. J. E. Roberts.** *Brit. J. of Radiology*, 12. *pp.* 246–251, *April*, 1939.—Methods of protecting healthy tissues from irradiation by β- and γ-rays during surface Ra treatment have been investigated physically by means of a thin-walled ionisation chamber. Special attention was paid to the possible influence of secondary β-radiation from the filter material. The protective powers of wax, Pb and Cu have been examined, and it is concluded that for most purposes Pb is the most satisfactory material, its high γ-ray absorption more than compensating for its comparatively large β-ray emission. A thin layer of Cu over the Pb filtration appreciably reduces the surface ionisation, but this may have little or no effect on the skin reactions owing to the low penetrating power of the secondary β-rays.
AUTHOR.

2255. **Terminology in Radiology and Illuminating Engineering. R. R. Newell.** *Radiology*, 32. *pp.* 270–274, *March*, 1939.—An analogy is traced between the problems of radiology and illuminating engineering, and quantitative concepts are compared for X-rays and light. In some cases new X-ray terms and units are proposed for concepts not generally considered in radiology, such as roentgen flux, roentgen flux density, intensity of an X-ray source and brightness of an X-ray source. Some simplifications of present day terminology by the use of these units are indicated. J. E. R.

See also Abstracts 1925, 2169.

OSCILLATIONS AND WAVES.

2256. **Propagation of Radio Waves over a Finitely Conducting Spherical Earth. B. van der Pol and H. Bremmer.** *Phil. Mag.* 27. *pp.* 261–275, *March*, 1939.—In a former article [see Abstract 3035 (1938)] it was pointed out that in the theory of the propagation of radio waves over a finitely conducting earth two different approximations for the many Bessel functions occurring in the problem can be introduced, *viz.*, (*a*) the more simple tang. approximation (up till now used by most workers in this field), and (*b*) the less simple Hankel approximation, which is required when the wave-length is small compared with the circumference of the earth. In the preceding paper the field on the surface of the earth due to an emitter on the ground was calculated with an exclusive use of this better Hankel approximation, whereas previously [see Abstract 5481 (1937)] the superiority of the approximation not being fully realised yet at the time, curves for the field above the ground were calculated with the aid of both approximations. The results obtained there have now been fully recalculated with the exclusive use of the Hankel approximation. In the new figures (given in this paper) the curves could be given ranging from the immediate proximity of the emitter up to well into the shadow region, due to the good fit existing in the transition region between the geometric optical formula and the residue formula. Here the formerly introduced " divergence factor " was numerically of great importance. AUTHORS.

2257. Diffraction and Refraction of a Horizontally Polarised Electromagnetic Wave over a Spherical Earth. M. C. Gray. *Phil. Mag.* 27. *pp.* 421–436, *April,* 1939.—Formulæ are derived for the electromagnetic field at a point on or above the surface of a spherical earth due to the presence of a vertical magnetic dipole. It is shown that the resultant field resembles that due to a vertical electric dipole above a spherical earth of low conductivity, and that in the magnetic case the values of the earth constants are of much less importance than in the electric. Curves are included showing the variation of the field with distance and with height. AUTHOR.

2258. The Lower Ionosphere. S. K. Mitra, J. N. Bhar and S. P. Ghosh. *Indian Journ. Phys.* 12. *pp.* 455–465, *Dec.,* 1938.—In the denser lower atmosphere, collisional frequency ν is so high that the condition $\mu < 1$ (μ = refractive index for electromagnetic waves) is not fulfilled. Calculation shows, however, that for a given value of ν, and for values of the electron density N greater than a calculable value, μ varies very rapidly with N. If an ionised layer similar to E or F is postulated, with an appropriate value of N, the change in μ within distances smaller than a wave-length may be large enough in this denser region to produce appreciable reflection. Using the expression for the reflection coefficient at metallic surfaces, it is shown that when $\nu = 10^8, 10^9, 10^{10}$ per sec. for a wave of frequency 4 Mc./sec., sufficient reflection is to be expected for $N = 10^{6\cdot5}$, $10^{7\cdot5}$, $10^{8\cdot5}$ cm^{-3} respectively. A discussion of possible modes of formation of the ionised regions indicates that ionisation of N_2 could account for the E_2 layer at 140 km, while ionisation of O_2 could produce the D layer at 55 km. J. P. A.

2259. The Ionosphere. E. V. Appleton. *Roy. Astron. Soc., M.N. Occasional Notes, No.* 3. *pp.* 33–41, *Jan.,* 1939.—A brief historical account prefaces a summary of the established facts and of the chief problems of contemporary ionospheric investigation. J. P. A.

2260. Lorentz " Polarisation " Correction in the Ionosphere. D. F. Martyn and G. H. Munro. *Terr. Mag.* 44. *pp.* 1–6, *March,* 1939.—The authors discuss criticisms by Appleton, Farmer, and Ratcliffe [see *Nature,* 141. *pp.* 409–410, *March* 5, 1938] and by Booker and Berkner [see Abstract 867 (1939)] of their former conclusion that the Lorentz polarisation-term is zero in the ionosphere. They advance further experimental facts in support of their viewpoint, and criticise the views of Appleton, Farmer and Ratcliffe in detail. The views of Booker and

Berkner are also criticised, and it is shown that their experimental results receive a simple explanation in terms of the authors' theory. AUTHORS.

2261. Radiation from Solar Flares and Radio Fade-Outs. T. H. Johnson and S. A. Korff. *Terr. Mag.* 44. *pp.* 23–27, *March*, 1939.—The intensity of the penetrating radiation at an elevation of 20 km. has been measured with a Geiger counter carried at a constant level by a balloon for a continuous interval including times before, during, and after a radio fade-out. No effect was found, and the precision of the measurement excludes the possibility of an increase of intensity as great as 2%. Assuming mass-absorption of the ionising radiation in a homogeneous atmosphere the limits of the absorption-coefficient are determined from (*a*) the negative result of the balloon experiment, (*b*) the total ionisation required in the region of high collision-frequency for the absorption of radio energy, and (*c*) the fact that the E- and F-layers are not appreciably altered as regards their ion-density during the fade-out. The analysis shows that the mass absorption-coefficient must lie between 0·1 and 25 per gm., or if the solar-flare radiation is of the nature of X-rays the wave-length must lie between 0·1 and 1·5 Å. AUTHORS.

2262. Nature of Radio Fade-Out. L. V. Berkner. *Phys. Rev.* 55. *pp.* 536–544, *March* 15, 1939.—Radio fade-outs in the earth's sunlit hemisphere coincident with bright solar chromospheric eruptions are examined by means of vertical-incidence recording of ionospheric echoes with a wide-range multifrequency technique. It is concluded from the series of observations examined that a fade-out is best described as an upward projection of the lower or absorption limit of echo-return, and that the fade-out is caused by intense absorption of ionising radiation, emanating from bright chromospheric eruptions, at the base of, or below, the E-region, that is, below the 110-km. level. It is shown that no appreciable absorption of chromospheric-eruption radiation takes place at levels higher than that of the E-region; therefore, a process of selective absorption must operate. Since the principal geomagnetic effect associated with fade-outs is an augmentation of the diurnal variation of terrestrial magnetism, it appears that only the Stewart-Schuster "atmospheric-dynamo" theory of diurnal variation is possible under the restrictions imposed by these observations. AUTHOR.

See also Abstracts 2010, 2261, and

1218B. Resonance Phenomena in Ionised Gases and their Effect on the Propagation Characteristics of Electromagnetic Waves. Y. Asami and M. Saito.

1219B. Propagation of Electromagnetic Waves. P. David.

PHOTOELECTRICITY.

2263. Thermal Theory of Metallic Photo-Resistance. Q. Majorana. *Accad. Lincei, Atti*, 28. *pp.* 217–221, *Nov.* 5, 1938.—A further discussion is given of the phenomena previously described [see Abstract 1429 (1939)], but a satisfactory explanation has not yet been found. It is suggested that the phenomena may depend on a special property of the more refrangible rays in which the Hg quartz lamp is particularly rich; or the facts observed may have some relation to the classical photoelectric phenomenon. But these hypotheses are not in accord and further observations are needed. J. J. S.

2264. Sensitisation of Reversible Photovoltaic Piles. S. Schlivitch. *Comptes Rendus*, 208. *pp.* 803–805, *March* 13, 1939.—Zn plates in $ZnSO_4$ solutions of various concentrations give only a very weak e.m.f. when one of the electrodes is illuminated by an arc. The effect in this case is thermal. If dyes (*e.g.*, methylene blue, uranine, rhodamine) are addded to the solution the sensitivity is not increased except when considerable concentrations of methylene blue are used, and the electrode is illuminated by a strong source. Cu plates in $CuSO_4$ solution do not show the Becquerel effect immediately after the cell is made up, but after standing for some time the surface of the electrode becomes covered with a coloured film which makes the plate sensitive to light. This forms more rapidly the more dilute the $CuSO_4$ solution. The sensitisation is accelerated by the addition of dyes. The effect seems to be due to the formation of a layer of oxide on the plate. The electrodes produced by placing Cu in a dye solution retain their properties when placed in other electrolytes, but sometimes the direction of the current is reversed. Other metals, *e.g.*, Pt, behave similarly but to a lesser degree than Cu. A. J. M.

2265. Actinoelectric Effects in Tartaric Acid Crystals. J. J. Brady and W. H. Moore. *Phys. Rev.* 55. *pp.* 308–311, *Feb.* 1, 1939.—Tartaric acid crystals illuminated with light from a carbon arc exhibit a flow of current when connected to a galvanometer without the aid of an impressed battery. This actinoelectric effect is greatly dependent upon the orientation of the crystal with respect to the illuminating beam of light. It is shown that a section of the crystal can be chosen which shows a series of equipotential lines when its surface is examined with two probes while the crystal is illuminated. The measured currents are about 10^{-12} A, when the crystal is illuminated with the light from a carbon arc. The effect is a linear function of light intensity for the lower light intensities, but increases more rapidly for higher intensities. The effect is practically independent of temperature in the range from 20° C. to −40° C. The maximum spectral response is at approximately 10,500 Å. AUTHORS.

PIEZOELECTRICITY.

See Abstract 1907 and

1234B. Can Crystals of Lesser Symmetry be Excited Piezoelectrically? B. Pavlík.

1235B. Anomalies of Thickness Vibration of Quartz Plates due to Non-Uniform Thickness. I. Koga and M. Tatibana.

1236B. Internal Friction in Quartz Crystals. R. Günther.

THERMOELECTRICITY.

2266. Simple Demonstration of Peltier Effect with Approximate Measurement. A. Campbell. *Phys. Soc., Proc.* 51. *pp.* 545–546, *May*, 1939.—Three strips of two metals *A* and *B* are soldered together to give junctions *P* and *Q*. A current *I* sent through the combination cools *P* and heats *Q*; when *I* is reversed, *P* is heated and *Q* cooled, these effects being shown by means of a galvanometer connected to an ion-constantan thermopile whose opposite junctions are close up to *P* and *Q* respectively. To obtain an approximate measurement, a current I_2 is sent through a short wire of resistance *R* close to the cooled junction. When the effects are small and I_2 is adjusted so as to make the galvanometer deflection zero, the Peltier effect constant Π is equal to $RI_2^2/2IT$, where *T* is the absolute temperature. AUTHOR.